National Service Number

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Electrical World

New York, September 1, 1917 McGraw-Hill Publishing Co., Inc. Vol. 70, No. 9 10c a copy

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Electrical World

The consolidation of Electrical World and Engineer and American Electrician
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The Glory of National Service

SERVICE is the shibboleth of our industry. Its insignia are stamped on the minds and consciences of managers and linemen alike in characters ineffaceably brilliant, and it would appear sometimes that the apparatus also was imbued with its spirit. It is the alpha and omega of the trade and profession, which scatters and yet increases and carries its own reward.

It were vain to picture the world to-day minus its electric transmission of intelligence, of light and of power. Society without them, though handicapped, would survive—industry never. In one form electricity traverses the heavens above, the earth beneath and the waters under the earth, communicating to every nation the achievements, aims and aspirations of the others, thus laying the foundation for a common human brotherhood. In another form the pent-up energies of the watercourses and of the fuel of the earth have been employed to ease the burdens on the shoulders of man and to give him light.

Having made itself indispensable to civilized communities in times of peace, it is but natural that in the emergency occasioned by the war the nation should seek to use the force of electricity in the rapid and successful prosecution of that combat, wherein every agency known to science is engaged. The response of its votaries to the nation's appeal has been prompt. In all that the industry has done in and through its great unit organizations it has had working a tenser degree of individual vitalized man power than it has ever developed before. That which the individuals have attempted, that which they are carrying through with energy made strong by patriotic fervor, is far more effective by reason of the tremendous corporate and organization units through which the industry mainly acts. But the organizations are relying for their stimulating imagination and their inspiration upon highly trained and carefully directed human mentalities.

The human element in the industry has always been a markedly conspicuous feature of its unusual progress. This is so plain to the ordinary observer that it has become a commonplace and is accepted like any other ordinary routine circumstance. The individual is known to a great extent through his labor with the larger unit to which much of his time is given. He works, invents, plans as an essential part of an organization broader in scope and interests because of its combination of individual forceful effort. He makes the aggregate result bulk heavier, and the benefit of the concentrated drive is in turn passed to the one whom industry at the moment is serving. At present it is the nation that is benefiting.

Complete details are not for the public just now. Too much is at stake involving the industry with the fate of the nation to permit disclosure of either detail or principle of much that is being done. But it is right that the industry should claim modestly that it is doing its bit in more ways than one. The assertion can be made even though for reasons of war the basis of it is withheld at the time. In loans and gifts of money, in the willing use of time and resources, in brains, in research, in invested capital, the industry is forward in serving its people and government.

Such service is not measured wholly by surface pledges, although it is fair that these should have been asked too. One has but to draw on his intimate knowledge of the high character of individuals composing the heart and soul of the industry to know that they have been ready with service. The incomparable Edison is a public word because of the picturesque favor with which the people of the whole land view him. He has not had to disguise the fact that he is working nearly twenty-four hours a day. And there are many many others, unknown outside of the industry, unknown outside of a small circle in the industry in some cases, who are doing in obscurity the utmost of which they are capable, and doing it just as willingly as the captains of industry.

All the precious traditions of the industry are being surpassed in this year of test for the freedom established by our fathers. Built essentially on a public service, doing more for the general public than for private users, the great body of men and their leaders recognize a keener sense of obligation this year. They are less apt to question, they are more apt to do first and question afterward. That exceptional service has to be given they accept as an opportunity, not as a burden. Manufacturer, central station, engineer, supplier of materials, all are rendering service.

We doubt if when the international skies are cleared any finger can point to our failure to grasp the opportunity provided by the national call of democracy. The conviction is firm in us that in any crisis the men who compose our great industry will meet the supreme test which the times bring. Everything which can be done by electrical men has been and will be done to further the glory and perpetuate the fair name of our country, its untarnished character, its institutions and its ideals.

The Searchlight in Practice

LIEUT. S. G. HIBBEN'S paper on our present searchlight equipment gives a very practical notion of the conditions that have to be met and the results reasonably to be expected. The searchlight for military or naval use is radically different from other projectors in that the fundamental quality sought is extreme concentration of the beam in order to obtain reasonably long range of observation. The improvements in recent years have been largely in the direction of securing the maximum concentration possible in the source of light by the use of cored and sometimes impregnated carbons worked at the highest practicable current density.

Given a light source of specified size, the angular dispersion of the beam, when the source is as nearly as possible in focus, depends on the dimensions of the mirror system, since the angular variation of the reflected beam at various parts of the source depends on the angular spread of the source as it would be seen from the point of incidence concerned. Therefore for shore work the standard mirror is 60 in. (1.52 m.) in diameter, which is about the largest dimension for which the glass projector mirror can be produced without extreme cost and liability to breaking. Many attempts have been made to substitute for the Mangin mirror generally used a parabolic metallic reflector, very attractive at first thought on account of its cheapness, simplicity and freedom from risk of breakage. In point of fact the difficulty of getting a sufficiently accurate figure on such a mirror and the still greater difficulty of holding that figure constant under the varieties of temperature are so great that no useful results have followed, although such mirrors are very successfully used in general projecting work where extreme concentration of the beam is not necessary. In the largest units here mentioned the current runs between 160 amp. and 180 amp., with about 55 volts at the arc, so that, as a reference to the table will show, the current density in the crater is pushed extremely high. Lieutenant Hibben gives an interesting approximate formula for the equivalent candlepower in the beam as compared with the intensity of the source. It at once appears from his figures that the multiplying factor as between source and beam candlepower rises to some 3000 in these great and accurately designed searchlights, a figure three or four times as high as is reached in common projector practice.

The illustrations of the searchlight in practice are rather striking. The range even of the 60-in. (1.52-m.) lamp on objects like the gray of a ship's war paint does not ordinarily exceed in the clearest air much over 10,000 yards (9.14 km.), while under average conditions it will not greatly exceed half this figure, and slight haze may cut the penetration down to 3000 yards or 4000 yards (2.74 km. or 3.96 km.). One of the great problems at present is how to deal with such conditions of low visibility both for picking up objects and for gunfire, and no entirely satisfactory answer has as yet been obtained.

One interesting matter is the direction of the beam in lighting up a target. Practice shows that the searchlamp should be so placed as to throw a beam well out of the immediate line of vision to avoid back glare from haze as well as to prevent giving too much information to the enemy, the most favorable direction being about 30 deg. off the line of fire. Besides the great lamps specially described by Lieutenant Hibben, there is a large field for the service for smaller and easily portable units to be used for lighting the front, for picking up air craft and similar purposes. These are on the whole less exacting in their requirements, but considering the height at which air craft now fly a beam of large penetrating power will often be required. Perhaps one of the most useful engineering tasks now at hand is the design of portable searchlight sets combining the maximum of efficiency with the minimum of liability and ease of transport.

Holding Coal Prices in Check

THE regulative hand of the government is far-extended in the effort to relieve industry from burdens made almost intolerable by the rapacity of coal producers and dealers. Price-fixing of coal strikes squarely at one of the worst features of the high-cost menace. It gives consumers ground for expecting that the skylarking which characterized coal quotations last winter will be certainly less evident during the coming season, and for hoping that it will not be evident at all in many communities. Whatever improvement it makes will be just that much net gain—that much more than would have been obtained in price concession otherwise.

Connected with the question of price is the question of quantity production. Price reduction alone will not solve the problem of coal consumers; stimulation of volume produced is of equal or greater importance. On the surface it appears that stimulation of production would have followed more liberal prices, that output would have jumped with the prospect of large profit. Against this outsider's point of view, however, we have the knowledge that the action taken at Washington was the definite result of analytical study of coal production costs and that in any event the prices are provisional. The eyes of the government are wide open as to the necessity of encouraging production. If the scale fixed is too low to yield a profit which will accelerate output, it is beyond argument that the scale will be altered.

It is the responsibility of getting enough coal for his plants which wears first upon the central station operator; he may balk at the price, but he pays it rather than stop service. With him it is more than a public obligation to continue service uninterruptedly, it is an honored tradition of the industry. So, while high coal prices have changed the calculations in cost sheets, he has kept steadily in mind the essential requirement. Facing the hard facts of exorbitant cost, he met the coal market as it was and he accepts it as it is to-day. Central stations are bound by contracts covering part of their coal necessities; they buy the proportion of

their coal not covered in this way in the supply-and-demand-regulated outside market. With the maturity of old agreements, contract prices have moved upward under the extraordinary pressure of the last year. Contracts did not hold good with coal operators in all cases last winter when outside dealers boosted bids and secured first call on the supply. We do not advocate that central stations treat agreements as lightly as some coal operators did. But with the shoe on the other foot, where the government has put it by repressing the runaway prices which were demoralizing industry, central stations have a very good talking point for negotiating with coal companies.

The Technique of Street Lighting

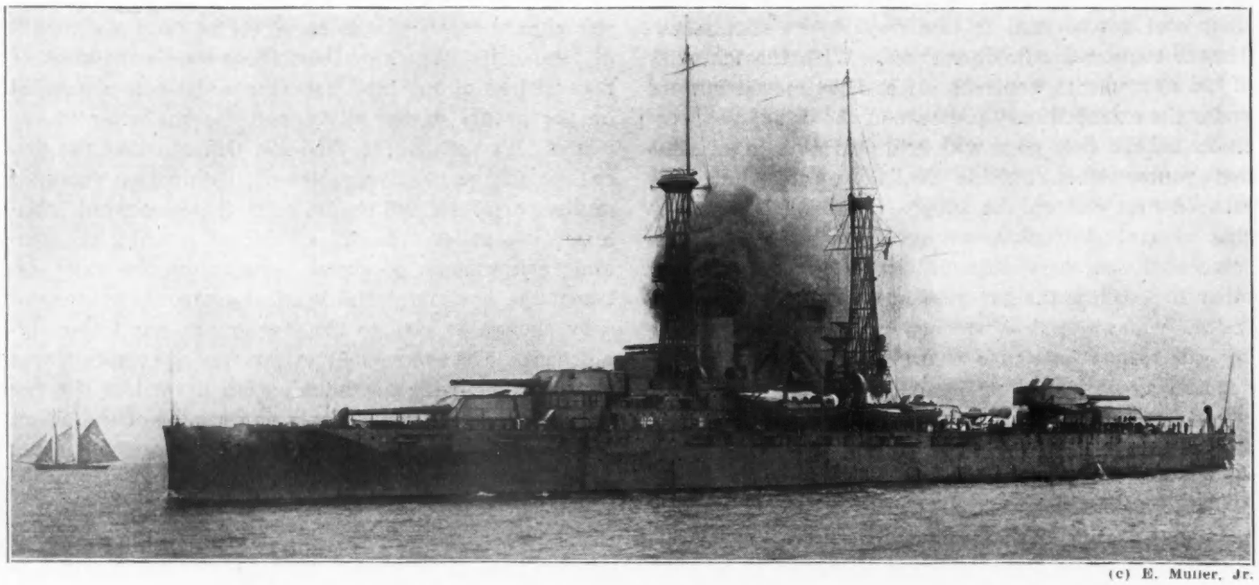
OUR readers will welcome James R. Cravath's first paper dealing with the lighting of cities of moderate size. A great metropolis has problems of its own and is so densely populated that special methods of lighting are both appropriate and justified by the conditions. Mr. Cravath's present paper deals with the general situation and the general principles that underlie proper illumination of the streets. Particularly instructive is his discussion of the difference between incident illumination and brightness, as reckoned with under the various conditions of seeing to be found in practice. The modern oiled road has somewhat complicated the lighting situation. Its normal surface is extremely dark and diffuses a very small proportion of the light, often no more than 6 or 8 per cent. On the other hand, its specular element of reflection, to use the technical term for Mr. Cravath's very descriptive "glint," particularly at large angles of incidence, is rather astonishingly large, especially when the surface is well polished by traffic, and it often looks in distant view considerably brighter than its surroundings or than the ordinary surface of an oiled street. This peculiarity is both an advantage and an evil—an advantage in that it tends to equalize the apparent brightness along the surface, as Mr. Cravath points out; a disadvantage, especially by day, in producing a serious element of glare.

At night the surface glint considerably increases the visibility of objects, because of silhouetting, but affects hardly at all and sometimes unfavorably the numerous objects which are seen chiefly in virtue of their shadows. These two conditions, silhouetting and shadowing, determine visibility of objects immediately on the roadway, the former being chiefly useful for large objects at a distance, the latter involving the details of the surface. In addition, there is the ordinary requirement of raising illumination high enough to render objects easily visible in virtue of their differences of luminosity. Which of these three conditions must be regarded as of primary importance depends somewhat on the nature of the street and the character of the traffic. We fully agree with Mr. Cravath that the discussion of the relative values of illumination reckoned on the horizontal and on the vertical is somewhat fruitless, since under ordinary conditions meeting the general requirements of street illumination the ratio between the horizontal and vertical components does not vary enough to give to the matter any particular significance. The common American way of compromising by reckoning with the illumination normal to the ray and taking into account lights on one side of the object only is perhaps as good a first approximation as could be desired.

Another matter not unworthy of detailed attention is that of glare. As Mr. Cravath points out, the best remedy for glare is increasing the height of lamps. This is desirable for other reasons as well. The statement that the use of a diffusing globe on the lamp has very little effect on the glare is considerably too broad, since the phenomenon of glare depends on the concentration of light in the image upon the retina, and not merely on the quantity which falls on the eye. This is one reason for the greater effect noted in nearly central vision as compared with the blurred peripheral vision produced by a lamp out of the main field of view. At distances which produce the image of the source in what is practically a point two lamps giving equal candlepower, one with and one without the diffusing globe, cannot be told apart and produce the same element of glare. At shorter distances a point is reached where the diffusing globe will produce materially less glare, and at still shorter distances the difference between the two becomes very marked indeed. The practical case in which this condition is particularly noticeable is in the use of gas-filled incandescent lamps close along the road, from which the glare is often very offensive in spite of the moderate candlepower in the source. Glare, too, is profoundly affected by the state of adaptation of the eye, so that the power and spacing of individual units is by no means a negligible factor, a condition particularly noticeable in the case of intense sources placed too far apart on an otherwise somewhat dark street. The technique of street illumination in the comparatively small places Mr. Cravath is discussing is perhaps on the whole somewhat more difficult than lighting in large cities, and the present series of articles we believe will be particularly welcome to those interested in the ordinary lighting problems where economy and efficiency must be shrewdly combined.

The Coming Issues

THE spirit of this issue will be carried out in subsequent issues of the ELECTRICAL WORLD. Besides articles on a systematic method of changing transformers and adjusting plant facilities to handle Central States coal instead of Eastern fuel, there will be a semi-technical article on the effect of field-circuit constants on transient short circuits in alternators. The second article in the series by James R. Cravath on street lighting for small towns and cities will be devoted to types of available and suitable lighting units for such installations.



(c) E. Muller, Jr.

Buying Electrical Materials for the Navy

Relations of the Navy Department and Its Large Requirements to the Electrical Industry Discussed by Rear Admiral McGowan—Co-operation of Wire Manufacturers

REAR ADMIRAL SAMUEL McGOWAN, paymaster general of the navy and chief of the bureau of supplies and accounts of the Navy Department, analyzed this week for the Washington correspondent of the ELECTRICAL WORLD the present situation of his division, which is making large purchases for the government, and which may make still larger purchases if Congress passes the bill which is now pending, providing for approximately 150 new torpedo-boat destroyers.

"The general situation of the Navy Department, so far as it concerns the purchase of electrical material," Admiral McGowan said, "concerns itself particularly with the purchase of electrical wire. Of this we are now buying about 1,000,000 ft. (304,800 m.) a month, wire of all classes and conditions. The getting of wire is the principal item at this moment. Our idea is that the country is short of wire production. The fact that this country is short of wire production is complicated by the fact that Great Britain, which has been the great world manufacturing center of wire, as well as dies used for drawing wire, is also short of production. This situation has been still further complicated by the fact, from the Navy Department's information, that the special steel which has been used for the manufacture of these dies has been made in Great Britain heretofore, and that there has not yet been developed in this country an adequate source of supply of this special steel.

"Nevertheless, the wire industry has been brought into very close contact with the Navy Department. We have just had a meeting here of all the manufacturers' representatives. We mentioned to them our requirements, and they have worked out a plan of procedure. A committee, consisting of prominent men in the industry, has been appointed. This includes LeRoy Clark of the Safety Insulated Wire & Cable Company, Wallace S. Clark of the General Electric Company and Edward Sawyer of the Atlantic Insulated Wire & Cable Company. This committee is informed from time to time of our requirements, and the committee endeavors to see to it that we get what we want, also that there shall be left ample production for our possible demands. The committee is a sort of co-ordinating element. In case quotations received on ordinary bids do not give satisfaction as to prices or deliveries, the committee ascertains the situation at each mill, and informs us what is necessary to get us what we want, arranging in some cases for raw materials or having shipments expedited by the government, also in some cases arranging to have ordinary commercial business set aside."

Government Needs

Admiral McGowan also discussed lamps and other electrical materials in connection with government policies, saying:

"Lamps are purchased through the general supply committee of the government, based on an efficiency test of the Bureau of Standards. We follow the recommendations of the Bureau of Standards. I think this is rather well known. But so far as electrical fittings are concerned, many of our fittings have been made lately at the Portsmouth Navy Yard. There has been some criticism of giving what might possibly be called commercial work to a government navy yard. What we did in respect to that and other government navy yards, however, was with the desire to conserve the labor force. With that for a short time we had some little difficulty.

"Now, however, the navy yards are filled with repair and construction work. We are no longer worried about maintaining our labor force in the yards.

"The tendency therefore now comes to get work

done by commercial firms—using our dies, our blueprints and drawings, and every other facility we now have available.

"Our ordinary stock requirements, such as material needed at the navy yards for repair work and maintenance work, are pretty well covered by existing contracts. Requirements for new construction of electrical material cannot be known very long in advance. At the present time that depends in one instance upon what Congress does. The department has sent in recommendations for about 150 torpedo-boat destroyers. If these are built within a short time there will be, of course, an enormous demand for electrical machinery. On other kinds of electrical machinery, principally motors, the production is very much below the present demand. There is not much demand right now for dynamo machinery, but ground was broken on Aug. 25 for the new armor-plate plant at Charleston, W. Va., and there will be some interest in that in the electrical industry."

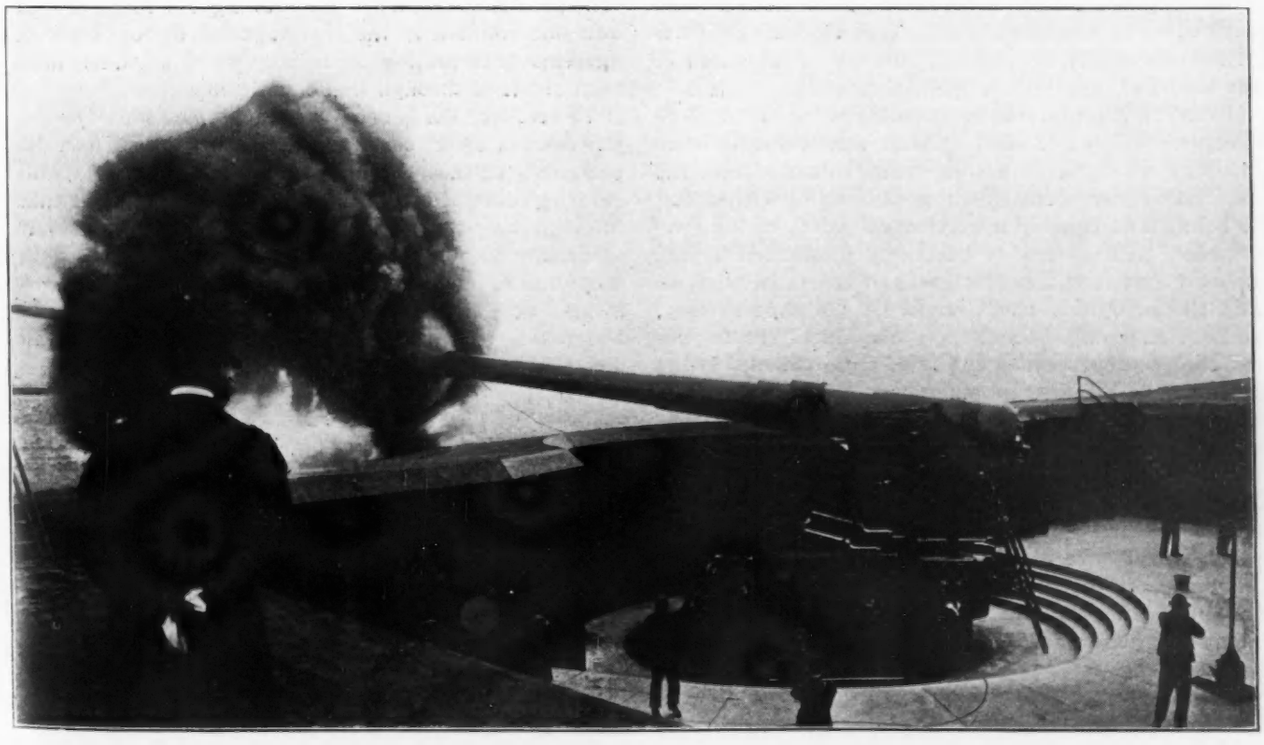
CO-OPERATION FROM THE GOVERNMENT

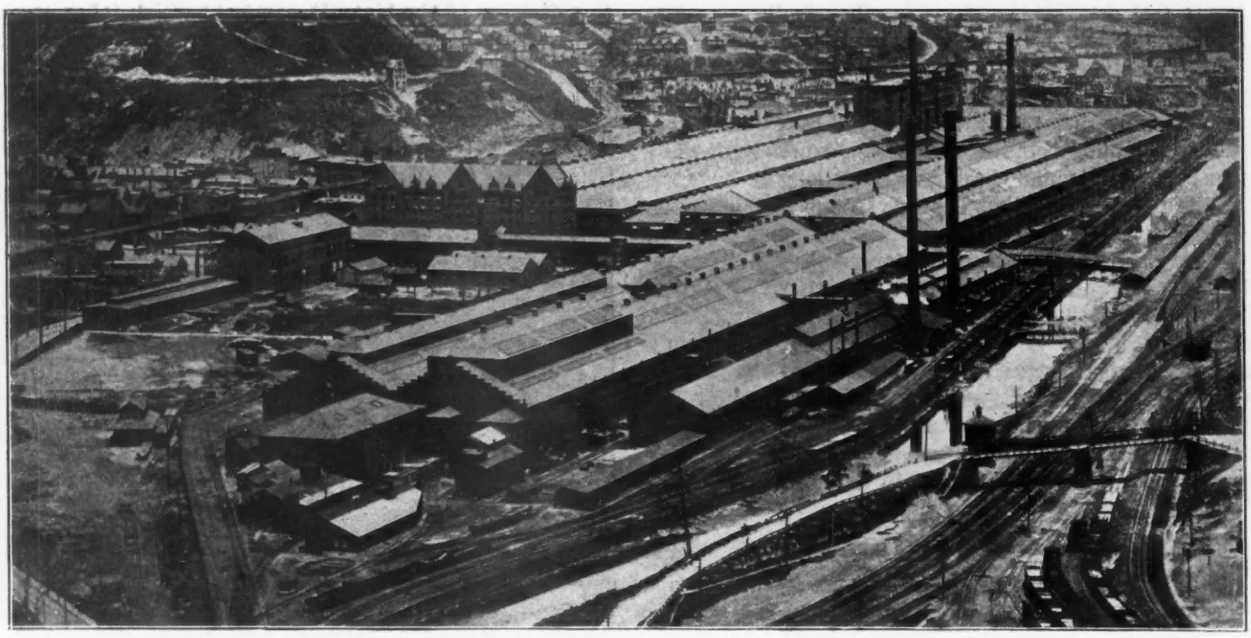
In pointing out how the government facilitates the work of manufacturers, Admiral McGowan said:

"So far, the industries have responded in a most commendable manner to the needs of the government. In order, in some cases, to get our war needs, we have been obliged, in a sort of way, to ask the War Industries Board to exercise priority over many important commercial requirements. Every one has been very cheerful about this work, however, and the industry can realize now that, in many ways, the government can be of assistance to it. The industry has found that the government can create a constant flow of raw material, and can possibly be of assistance in the labor situation. The government can help out on the question of the car supply in the way of getting materials to or product from mills and factories. All that we ask is that the industry establish the need for the materials and tell us how we can help. We have organized a section in this division of the Navy Department which takes care of that kind of work solely.

"We feel that we have made it to the interest of the industry to understand that it is dollars and cents in pocket to have a navy contract. That works toward creating a good will toward the navy. That is what we want to get. If we can get that we are always assured of our source of supply at fair prices."

U. S. SUBMARINE AND TRANSPORT





EAST PITTSBURGH WORKS OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY ACTIVE IN WAR-TIME WORK

Manufacturers Help in the War Program

The Work of the Associated Manufacturers of Electrical Supplies in Aiding the Government—Great Manufacturing Companies Turn Resources to National Service—Individuals Do Their Part

THE Associated Manufacturers of Electrical Supplies has shown from the first a keen interest and desire to aid in the work of supplying the government with such material as is covered by the products of the manufacturers embraced in its membership.

As early as January, 1916, President Robert K. Sheppard wrote to President Wilson, tendering the facilities of the association in planning for the mobilization of the electrical industry for the benefit of the country.

Later, in a conference in Washington with the manufacturers of wires and cables, arrangements were made by which three leading manufacturers from the association were constituted a supervising committee, to handle and equably apportion all orders of the government, with a view to hastening production by the various American manufacturers of insulated wire, so that the emergency needs might be met expeditiously, without imposing upon a few manufacturers an unreasonable proportion of the total requirements, to the detriment of business in general.

The manufacturers agreed with the supervising committee to accept such apportioned orders and to fill them at prices determined by agreement between the department and the supervising committee. The result of this has been prompt shipments, saving many months which would have been required under the usual procedure.

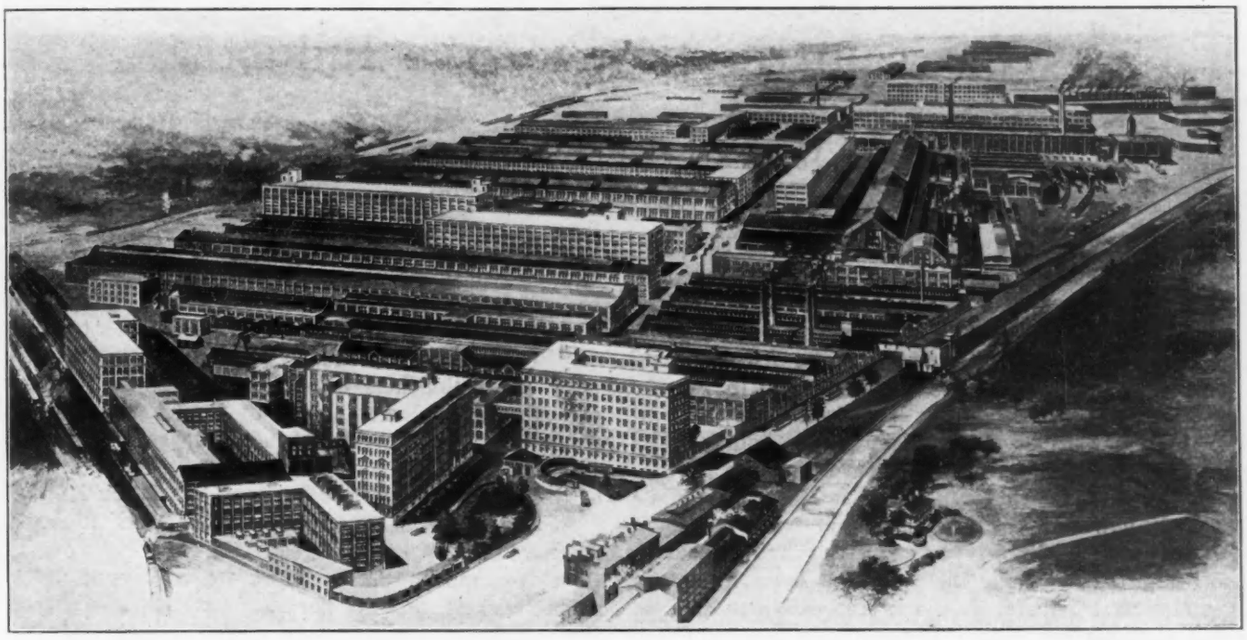
The demands of the government covered in large quantities hundreds of devices manufactured by the various members of the association, including lamp receptacles and sockets, fuses, porcelain of all kinds, certain lines of overhead insulating material and certain kinds of fixtures, and recently large orders have been placed for fan motors, and in meeting these demands similar methods have been adopted in the various sections of the association as were used in the furnishing of wire and cable. The manufacturers met and compared their facilities for meeting the requirements and this resulted in the acceptance of the orders with agreements on matters of delivery which could not have been obtained through individual companies.

The office of the general secretary, Charles E. Dustin, has been in direct communication with the various departments of the government, submitting detailed data covering the products of members, so segregated that the department could know readily to whom to submit specifications for requirements. This has resulted in large orders having been placed with prompt deliveries in each case, the different members co-operating with a view to giving the government their best efforts in all directions.

General Electric Enlarges Facilities

The General Electric Company has increased its manufacturing capacity and output at an unprecedented rate as a result of the industrial and war activities. Both industrial orders and requirements in connection with work needed by the government have justified extensive enlargement of production facilities. Much new construction is planned or under way at the main Schenectady works and at other plants of the company and its subsidiaries.

Not only through the use of its manufacturing resources, but also through the services of a number



SCHENECTADY WORKS OF THE GENERAL ELECTRIC COMPANY, WHERE MUCH APPARATUS IS BEING MANUFACTURED

of officials and employees the company is rendering service to the government. Work which is being done is of a confidential nature, but it is of the largest measure of service to the country. In such work the closest co-operation is arranged with the government forces so that the outcome may be of the maximum possible advantage.

As of Jan. 1, 1917, the total manufacturing floor space of the plants of the General Electric Company was 15,301,000 sq. ft. (1,407,000 sq. m.). From Jan. 1 to date (Aug. 29) there has been completed additional floor space aggregating 1,000,000 sq. ft. (92,900 sq. m.), in addition to which there are under construction buildings with an aggregate floor space of 2,600,000 sq. ft. (239,200 sq. m.), of which from 40 to 50 per cent will be completed by Jan. 1, 1918.

Large New Westinghouse Plant

Of the new activities undertaken by the Westinghouse Electric & Manufacturing Company the largest is the construction of the plant at Essington, Pa. The entire production of this plant can be applied to government service. On part of the 500 acres (202 hectares) comprising the site of the Essington plant buildings now under construction will provide an aggregate of 14 acres (5.6 hectares) of floor space. Already partial operation has been started, and it is expected that the buildings now planned will be ready for complete manufacturing uses by Dec. 1. The present construction program will furnish 25 to 30 per cent of the ultimate plant planned for this point. Turbines and condensers will be the first products manufactured at the Essington plant. The largest works of the Westinghouse company, at East Pittsburgh, occupy 53 acres (21.4 hectares) of land, so that there is abundant room for expansion at Essington to a size far beyond that of the earlier manufacturing headquarters.

The Essington site has a frontage of 1¼ miles (2 km.) on the Delaware River. The first contracts for materials were let early in January, and every effort has been made to rush construction. An enormous amount of underground work has been done. In the first development there are 5 to 6 miles (8 to 9.6 km.) of railroad track. Westinghouse, Church, Kerr & Company have charge of the designing and construction. The work is under the supervision of Calvert Townley, assistant to the president of the Westinghouse Electric & Manufacturing Company.

As in the case of other companies, individuals connected with the Westinghouse company are serving the government in various capacities.

Western Electric Company Activities

Dependence upon the maintenance of communication in modern warfare places a large part of the Western Electric Company personnel in a position where it can serve the country to excellent advantage. Particularly is this true of the engineering department, which consists of men trained for telephone and telegraph work in both wire and wireless branches. From among them two complete radio or field telegraph companies have been recruited and are ready for intensive training.

A number of engineering department and other executives whose training has fitted them for such service have received commissions in the Signal Officers' Reserve Corps. Others hold commissions in the National Guard, the Quartermasters' Reserve Corps, the navy and the Naval Militia. The ranking Western Electric officer is Major F. B. Jewett, S. O. R. C., chief engineer of the company.

The number of men who are already under oath to the government is 806, and 450 of these are now in active service. The total number of men registered under the draft law is 9676, but no data are available as to the number actually in the first call.

Among other companies, the Crocker-Wheeler Company is doing important work. The Wagner Electric Manufacturing Company has been awarded contracts for the manufacture of munitions, as explained more fully in the news columns of this issue. A number of other companies are engaging in activities which provide materials for the prosecution of the war.

War Contributions of the Industry

Indications That Subscriptions to Liberty Loan and Red Cross Funds Reach Hundred-Million-Dollar Mark—Number of Men Registered Under Selective Draft Also Shown

SPECULATION has been rife over the extent to which the electrical industry has contributed in men and money to the successful conduct of the war. There follow detailed statistics showing subscriptions by utilities, manufacturers, jobbers and others and their employees of $46,625,000 in Liberty bonds and $2,236,862 to the Red Cross fund, and indicating that 29,065 men registered. In addition, the companies here reporting have furnished the government with 6824 men for national service. As will be noticed, however, these statistics are not complete.

On the basis of the reports received there should be no hesitation in saying that the total subscriptions of the electrical industry to the Liberty Loan reached at least $100,000,000, while it is doubtful if the Red Cross subscription fell far short of $5,000,000. It is not easy to estimate the number of men engaged in the industry who have been registered under the selective draft. Almost 30,000 are here reported, and it is reasonable to believe therefore that the total will be in excess of 50,000. In like manner the indications are that around 15,000 men from the industry are in national service.

Several ambulances have been donated by members of the industry, including one by the Electrical Supply Jobbers' Association, for which $2,000 was appropriated. Another fund to which money was subscribed was that of the Y. M. C. A. for work among the national forces.

At the outbreak of the war there were in round numbers 275,000 men engaged in the electrical industry. Of this number, 18.2 per cent are registered in the selective draft, and 5.7 per cent have already entered the nation's service. By the end of the current year another ten or fifteen thousand will undoubtedly be mustered in, a loss in man power of around 10 per cent.

Name of Company	Liberty Loan Subscription	Red Cross Subscription	Listed and Drafted
Alva (Okla.) Light & Power Co.	.....	$110	1
American Brass Co., Waterbury, Conn.	$1,000,000	....	...
American Railways Co., Philadelphia, Pa.	100,000	....	...
Amer. Tel. & Tel. Co., New York, N. Y. } Bell System }	8,692,100	582,500	4,600
American Transformer Co., Newark, N. J.	3,800	....	12
American Lava Co., Chattanooga, Tenn.	7,300	1,000	4
Anderson Electric Car Co., Detroit, Mich.	50,000	....	200
Antigo (Wis.) Electric Co.	150	25	8
Androscoggin Electric Co., Lewiston, Me.	2,100	250	32
Ansonia (Conn.) Electric Co.	60,000	....	27
Archbald Brady Co., Syracuse, N. Y.	2,850	768	6
B. F. Ashcroft & Sons, Sulphur Spgs., Tex.	1,050	....	...
Atlantic Coast Elec. Co., Asbury Park, N.J.	.....	....	5
Austin & Co., M. B., Chicago, Ill.	4,100	400	25
Baker & Co., Newark, N. J.	16,000	1,250	6
Baylis & Co., Bloomfield, N. J.	5,000	150	...
Belden Mfg. Co., Chicago, Ill.	12,550	2,176	109
Beloit (Wis.) Water, Gas & Electric Co.	.....	....	6
Benjamin Electric Co., Chicago, Ill.	16,000	1,300	102
Benton Harb. (Mich.) & St. Joe Ry. & Lt. Co.	.....	600	13
Binghamton (N. Y.) Ry. Co.	5,000	326	16
Bliss Co., E. W., Brooklyn, N. Y.	75,000	25,000	150
B-R. Elec. & Tel. Mfg. Co., Kansas City, Mo.	27,750	670	21
Brown Instrument Co., Philadelphia, Pa.	6,500	....	...
Bruce-Macbeth Engine Co., Cleveland, Ohio	4,900	900	33
Burke Electric Co., Erie, Pa.	20,000	2,000	150
H. M. Byllesby & Co., Chicago, Ill.	500,000	25,000	...
Cambridge (Mass.) Electric Light Co.	53,000	500	5
Cameron Electric Mfg. Co., Ansonia, Conn.	11,700	....	19
Campbell Electric Co., Lynn, Mass.	2,250	350	15
Capital Electric Co., Salt Lake City, Utah	2,750	700	40
C & C Electric Mfg. Co.	5,000	....	22
Central Hudson Gas. & Elec. Co., Poughkeepsie, N. Y.	29,700	1,000	74
Central Indiana Ltg. Co., Indianapolis, Ind.	100	33	...
Central Maine Power Co., Augusta, Me.	.....	....	...
Central Mass. Electric Co., Palmer, Mass.	2,800	....	...
Central Power Co., Grand Island, Neb.	650	75	14
Century Electric Co., St. Louis, Mo.	50,000	5,000	...
Charlottesville (Va.) & Albemarle Ry. Co.	250	125	6
Chattanooga (Tenn.) Ry. & Light Co.	6,250	....	46
Cheyenne (Wyo.) Light, Fuel & Power Co.	1,000	410	7
Cities Service Co., New York, N. Y.	.....	....	...
Citizens Light & Power Co., Adrian, Mich.	9,100	*....	3
Cliff Elec. Distributing Co., Niagara Falls	3,050	*†500	2
Clinton (Mass.) Gas Light Co.	600	50	2
Cohoes (N. Y.) Gas Light Co.	4,150	100	8
Columbia & Montour Electric Co., Bloomsburg, Pa.	2,200	199	8
Columbus (Ohio), Delaware & Marion Ry.	1,000	500	...
Combustion Eng'g Corp., New York, N. Y.	6,000	....	...
Commonwealth Edison Co., Chicago, Ill.	1,070,000	31,500	1,800
Consolidated Gas Co., New York, N. Y.	5,700,000	....	...
Consol. Gas, El. Lt. & Pr. Co., Baltimore	211,000	100,000	1,100
Cope, T. J., Philadelphia, Pa.	100	25	...
Corpus Christi (Tex.) Railway & Light Co.	50	....	9
Cortland (Ohio) Lighting Co.	1,500	250	5
Crocker Wheeler Co., Ampere, N. J.	167,500	8,500	50
Cumberland County Power & Light Co., Portland, Me.	34,450	1,000	125
Cutter Co., George, South Bend, Ind.	4,750	465	...

Name of Company	Liberty Loan Subscription	Red Cross Subscription	Listed and Drafted
Dayton (Ohio) Power & Light Co.	.....	$3,250	101
Detroit (Mich.) Fuse & Mfg. Co.	$6,400	235	15
Doehler Die Casting Co., Brooklyn, N. Y.	7,400	1,700	...
Dossert & Co., New York, N. Y.	10,400	100	12
Douglas (Ariz.) Traction & Light Co.	.....	350	6
Dubuque (Ia.) Electric Co.	22,000	370	58
Dunham, Garrigan & Hayden Co., San Francisco, Cal.	143,500	3,500	13
Eastern Oregon Lt. & Pwr. Co., Baker, Ore.	1,450	450	12
Economy Fuse & Mfg. Co., Chicago, Ill.	80,000	....	...
Edison Elec. Ill. Co. of Brooklyn, N. Y.	540,000	....	...
Edison Electric Light & Power Co. of Amsterdam, N. Y.	1,200	26	6
Elec. Bond & Share Co., New York, N. Y.	200,000	....	...
Electric Fuse Guard Co., Newark, N. J.	500	....	3
Electric Machinery Co., Minneapolis, Minn.	3,000	....	20
Electric Ry. & Manufacturers Supply Co., San Francisco, Cal.	4,000	390	...
Elec. Sales Service Co., San Francisco, Cal.	1,200	350	1
Electric Storage Battery Co., Phila., Pa.	44,950	7,934	...
Electric Supply Co., Memphis, Tenn.	10,000	100	4
Electric Sup. & Equip. Co., Hartford, Conn.	1,500	†....	5
Electrical Supply Co., New Orleans, La.	100	50	8
Electrical Testing Lab., New York City	57,400	†....	...
Electro Dynamic Co. } Electric Boat Co. } Bayonne, N. J.	2,270,950	3,377	104
Elkins (W. Va.) Power Co.	1,000	....	1
Elliott-Lewis Electrical Co., Phila, Pa.	3,600	50	8
Emerson Electric Mfg. Co., St. Louis, Mo.	30,000	1,000	...
Empire State Gas & Elec. Assn., N. Y. City	1,000	250,000	...
Esco Electric Supply Co., Albany, N. Y.	1,000	....	5
Eugene Munsell Co., New York, N. Y.	13,000	....	...
Eugene (Ore.) Water Board	200	....	5
Eureka Co., North East, Pa.	9,600	1,200	37
Excelsior Springs (Mo.) Water, Gas & Electric Co.	500	....	5
Federal Sign System (Elec.), Chicago, Ill.	35,100	584	19
Ferracute Machine Co., Bridgeton, N. J.	10,000	....	12
Florida Elec. Supply Co., Jacksonville, Fla.	1,050	35	...
Gas & Elec. Improvem't Co., Boston, Mass.	5,350	60	...
Gardner (Mass.) Electric Light Co.	400	100	...
General Electric Co., Schenectady, N. Y.	8,002,900	....	2,000
General Light & Power Co., Cloquet, Minn.	5,700	....	7
Globe Mfg. Co., Perry, Ia.	2,250	....	1
Gloucester (Mass.) Electric Co.	500	10	3
B. F. Goodrich Co.	750,000	15,000	1,200
Great Barrington (Mass.) Elec. Light Co.	1,100	55	3
Great Western Power Co., San Francisco.	40,000	....	...
Greenfield (Mass.) Elec. Light & Power Co.	15,000	100	42
Gulfport (Miss.) & Miss. Coast Tract. Co.	2,000	425	...
Guerney Ball Bearing Co., Jamestown, N.Y.	75,100	....	...
G & W Electric Specialty Co., Chicago, Ill.	800	150	7
Hartford (Conn.) Electric Light Co.	13,850	....	132
Harvey Hubbell, Inc., Bridgeport, Conn.	10,000	2,500	80
Harwood Electric Co., Hazelton, Pa.	7,050	137	87
Holabird Electrical Co., San Francisco, Cal.	1,550	25	5
Holyoke (Mass.) Water Power Co.	100,000	....	...
Home Gas & Electric Co., Greeley, Col.	100	100	10
Home Wire Co., New York, N. Y.	100,000	5,700	383
Hoopeston (Ill.) Gas & Electric Co.	.....	....	3
Hoover Suction Sweeper Co., New Berlin.	13,000	....	25
Hubbard & Co., Pittsburgh, Pa.	87,000	2,500	150

Name of Company	Liberty Loan Subscription	Red Cross Subscription	Listed and Drafted
Hughes Electric Heating Co., Chicago, Ill.	$8,000	$5,900	18
Huntington (Ind.) Light & Fuel Co.	12,000	1,200	11
Hurley Machine Co., Chicago, Ill.	7,350	5,800	29
Huron (S. D.) Light & Power Co.	3,200	111	6
Illinois Electric Co., Los Angeles, Cal.	2,650	100	8
Illinois Traction Co., Peoria, Ill.	.....	....	...
Indiana Rys. & Light Co., Kokomo, Ind.	.....	5,100	...
Inter-Mountain Electric Co., Salt Lake City, Utah	7,600	500	21
Interstate Pub. Serv. Co., Indianapolis, Ind.	3,650	154	12
Iowa City (Ia.) Light & Power Co.	750	50	10
Iron City Electric Co., Pittsburgh, Pa.	7,200	600	15
Jackson (Tenn.) Railway & Light Co.	.....	300	11
Jamesville (Wis.) Electric Co.	7,000	175	8
Johns-Pratt Co., Hartford, Conn.	35,000	2,150	66
Keene (N. H.) Gas & Electric Co.	500	250	5
Keene (N. H.) Mica Products Co.	4,700	200	12
Kimble Electric Co., Chicago, Ill.	.....	100	...
Laclede Gas Light Co., St. Louis, Mo.	200,000	16,000	439
Laconia (N. H.) Gas & Electric Co.	600	210	0
Lakewood (N. J.) & Coast Electric Co. / Commonwealth Elec. Co., Summit, N. J.	17,000	....	...
Leeds & Northrup Co., Philadelphia, Pa.	.....	....	60
Leighton (Pa.) Electric Light & Power Co.	1,100	....	1
Liberty Light & Power Co., Richmond, Ind.	3,500	80	...
Light & Development Co. of St. Louis, Mo.	50,000	....	...
Lincoln Electric Co., Cleveland, Ohio.	6,200	750	100
Lineman Protector Co., Detroit, Mich.	.....	139	...
Litscher Electric Co., C. J., Grand Rapids	10,000	900	3
Lux Mfg. Co., Hoboken, N. J.	15,000	100	12
McCarthy Bros. & Ford, Buffalo, N. Y.	7,700	750	15
McEwen Bros., Wellsville, N. Y.	.....	445	10
McGraw Co. { Omaha, Neb. / Sioux City, Ia. }	1,500	1,000	60
McGraw-Hill Pub. Co., New York, N. Y.	110,000	1,000	...
McNaughton, McKay Electric Co., Detroit	1,550	150	4
Mackay Companies, New York, N. Y.	1,000,000	....	...
Macon (Ga.) Railway & Light Co.	.....	1,000	40
Mahoning & Shenango Railway & Light Co., Youngstown, Ohio	128,000	580	432
Manchester (N. H.) Trac., Lt. & Pwr. Co.	6,600	1,013	...
Manhattan Elec. Sup. Co., New York, N. Y.	250,000	....	...
Marshall Wells Hardware Co., Portland, Ore.	54,000	....	25
Melicrate Mfg. Co., New York, N. Y.	200	....	...
Menominee (Mich.) & Marinette Light & Traction Co.	2,100	....	6
Metropolitan Eng'g Co., Brooklyn, N. Y.	50,000	....	...
Middle West Utilities Co., Chicago, Ill.	129,000	7,850	...
Minnesota Gas & Electric Co., Albert Lea, Minn.	1,200	300	4
Minnesota Utilities Co., Chisholm, Minn.	1,500	85	10
Missouri & Southeastern Utilities Co., Blythesville, Ark.	100	....	2
Mitchell-Rand Mfg. Co., New York, N. Y.	1,050	....	1
Mitchell (S. D.) Power Co.	1,500	15	2
Moberly (Mo.) Light & Power Co.	650	200	10
Mohawk Elec. Supply Co., Syracuse, N. Y.	.....	‖....	8
Mohrite Co., Urbana, Ohio	150	‖....	11
Montana Electric Co., Butte, Mont.	2,500	572	3
Morris & Somerset Electric Co., Morristown, N. J.	2,600	....	10
Mountain Electric Co., Denver, Col.	550	118	4
Municipal Gas Co., Albany, N. Y.	119,950	432	84
Narragansett Electric Lighting Co., Providence, R. I.	26,000	115	34
National Electrical Credit Men's Association, Chicago, Ill.	.....	125	...
National Pipe Bending Co., New Haven.	2,000	15	4
National Tank & Pipe Co., Portland, Ore.	6,500	....	1
Newburyport (Mass.) Gas & Electric Co.	9,950	520	10
New England Butt Co., Providence, R. I.	21,000	500	10
New England Power Company System, Worcester, Mass.	6,800	1,250	90
New Process Gear Corp., Syracuse, N. Y.	23,300	13,740	48
New York (N. Y.) Edison Co.	303,050	....	...
New York (N. Y.) Insulated Wire Co.	50,000	....	...
Niagara Falls (N. Y.) Power Co.	1,023,700	26,900	62
North Carolina Electric Power Co., Asheville, N. C.	5,000	....	210
Northern Connecticut Light & Power Co., Thompsonville, Conn.	1,000	150	8
Northern Electric Co., Minneapolis, Minn.	.....	....	6
Northern White Cedar Assoc. Members, Minneapolis, Minn.	22,850	3,690	...
Northwestern Electric Equipment Co., St. Paul, Minn.	15,250	1,000	10
Nussbaum Co., V. M., Ft. Wayne, Ind.	1,550	27	3
Oconto (Wis.) Service Co.	.....	20	...
Ohio Brass Co., Mansfield, Ohio	25,000	500	...
Okonite Co., New York, N. Y.	42,100	1,060	...
Olean (N. Y.) Electric Light & Power Co.	450	580	9
Olympia (Wash.) Light & Power Co.	.....	500	5
Pacific Gas & Elec. Co., San Francisco, Cal.	386,400	....	...
Pacific States Elec. Co, San Francisco, Cal.	12,000	1,100	12
Packard Electric Co., Warren, Ohio.	10,300	793	158
Page Woven Wire Fence Co., New York.	92,200	1,500	...
C. D. Parker & Co. Properties, Boston.	29,200	....	...
Parker & Son, J. H., Parkersburg, W. Va.	2,750	100	1
Penn Central Lt. & Power Co., Altoona, Pa.	10,000	350	109
Pennsylvania Water & Power Co., Holtwood, Pa.	.....	50,000	...
People's Gas & Electric Co., Savanna, Ill.	1,700	100	1
Pettingell Andrews Co., Boston, Mass.	20,000	1,250	...
Philadelphia (Pa.) Electric Co.	425,000	....	943
Philadelphia (Pa.) Hydro-Electric Co.	15,000	....	1
Phillips, Leo A., New York, N. Y.	1,000	....	...
Pine Bluff (Ark.) Co.	$2,200	$383	2
Portland (Ore.) Ry., Light & Power Co.	35,400	4,150	574
Port Glover Electric Co., Cincinnati, Ohio	15,000	500	10
Public Service Co. of Northern Illinois.	250,000	7,500	...
Public Service Corp. of N. J., Newark, N. J.	770,350	15,000	...
Public Service Operating Co., Owatonna.	.....	....	6
Queensboro (N. Y.) Gas & Electric Co.	30,550	....	...
Quincy (Ills.) Gas, Electric & Heating Co.	1,350	40	5
Reliance Elec. & Engin'g Co., Cleveland, O.	2,500	1,125	30
Robbins Electric Co., Pittsburgh, Pa.	1,000	300	8
Robbins & Myers, Springfield, Ohio.	79,000	10,754	393
Robertson Cataract Elec. Co., Buffalo, N. Y.	24,300	2,400	12
Rochester (N. Y.) Ry. & Light Co.	44,650	2,650	248
Rockland (Me.) Thomaston & Camden Street Ry. Co.	4,500	450	10
Rogers (Ark.) Light & Water Co.	650	37	4
Rosewell (N. M.) Gas & Electric Co.	.....	....	8
Roth Bros. & Co., Chicago, Ills.	1,500	90	46
Rutenber Electric Co., Marion, Ind.	.....	125	10
St. Cloud (Minn.) Public Service Co.	10,150	300	...
St. Paul (Minn.) Electric Co.	4,100	320	11
St. Petersburg (Fla.) Lighting Co.	1,600	125	5
Salisbury (Md.) Light, Heat & Power Co.	2,500	100	8
Sangamo Electric Co., Chicago, Ills.	15,500	1,000	...
San Joaquin Light & Pwr. Co., Fresno, Cal.	30,650	5,511	63
Schenectady (N. Y.) Illuminating Co.	6,450	5,000	...
Shapiro & Aronson, New York, N. Y.	5,350	....	5
Shawnee (Okla.) Gas & Electric Co.	650	¶....	6
Sherwin-Williams Co.	200,000	50,000	...
Simplex Wire & Cable Co., Cambridge, Mass.	116,400	....	...
S. Morgan Smith, York, Pa.	100,000	....	20
South Norwalk (Conn.) Electric Works.	.....	....	9
Southern Cal. Edison Co., Los Angeles, Cal.	250,000	200,000	...
Southern Illinois Ry. & Power Co., Harrisburg, Ill.	.....	....	18
Southern Sierras Pwr. Co. / Nevada-Cal. Pwr. Co. and Associated Companies } Riverside, Cal.	7,300	1,775	135
Southwest General Elec. Co., Dallas, Tex.	38,200	1,014	52
Southwestern Gas & Electric Co., Texarkana (Ark.) Division	1,800	....	...
Spray Engineering Co., Boston, Mass.	8,700	....	14
Standard Underground Cable Co., Pittsburgh, Pa.	135,200	50,000	300
Standard Woven Fabric Co., Walpole, Mass.	30,000	200	73
Stanley & Patterson, New York, N. Y.	8,000	....	25
Steam & Elec. Mchry. Co., Bay City, Mich.	2,000	200	...
Swett Iron Works, A. L., Medina, N. Y.	6,000	1,200	...
Tennessee Eastern Electric Co., Johnson City, Tenn.	500	232	9
Charles H. Tenney & Co., Boston, Mass.	62,700	....	67
Terre Haute, Indianapolis (Ind.) & Eastern Traction Co.	.....	....	50
Terry Steam Turbine Co., Hartford, Conn.	105,950	4,012	...
Texas Gas & Electric Co., Houston, Tex.	5,000	500	14
Toledo, Bowling Green & Southern Traction Co., Findlay, Ohio	5,000	....	10
Tower Binford Electric & Mfg. Co., Richmond, Va.	750	10	0
Trumbull Elec. Mfg. Co., Plainville, Conn.	12,050	1,774	...
Union Electric Co., Pittsburgh, Pa.	11,000	1,430	16
Union Elec. Lt. & Pwr. Co., St. Louis, Mo.	.....	§811	127
Union Elec. Supply Co., Providence, R. I.	.....	....	2
Union Gas & Electric Co., Cincinnati, Ohio	737,500	10,385	460
Union Metal Mfg. Co., Canton, Ohio.	10,000	500	...
United Electric Light & Power Co., New York, N. Y.	61,000	....	...
United Lt. & Rys. Co., Grand Rapids, Mich.	79,600	....	...
Virginia Ry. & Power Co., Richmond, Va.	50,000	....	...
Wabash Valley Electric Co., Clinton, Ind.	.....	....	4
Wagner Electric Mfg. Co., St. Louis, Mo.	100,000	10,000	496
Walker Co., Henry L., Detroit, Mich.	.....	....	...
Walker Vehicle Co., Chicago, Ill.	506,600	....	...
Ward Leonard Elec. Co., Mt. Vernon, N. Y.	9,000	....	17
Ward Motor Vehicle Co., Mt. Vernon, N. Y.	.....	....	...
Ware County Light & Power Co., Way Cross, Ga.	200	340	5
Washington Elec. Supply Co., Butte, Mont.	3,000	150	3
Washington Pipe & Foundry Co., Tacoma.	20,000	500	10
Washington Water Power Co., Spokane.	19,600	4,716	25
Waynesboro (Pa.) Elec. Light & Pwr. Co.	.....	....	5
Webster (Mass.) & Southbridge Gas & Electric Co.	4,500	....	0
Westboro (Mass.) Gas & Electric Co.	.....	5	0
Westchester Light'g Co., Mt. Vernon, N. Y.	37,200	....	...
Western Electric Co., New York, N. Y.	.....	....	9,676
Western United Gas & Electric Co., Aurora, Ill.	8,500	50	...
Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.	2,900,000	471,000	...
West Indiana Utilities Co., Brazil, Ind.	.....	30	1
Wilson Co., H. A., Newark, N. J.	17,150	100	3
Wisconsin Pub. Serv. Co., Green Bay, Wis.	4,500	20	45
Wisconsin Valley Elec. Co., Wausau, Wis.	6,500	300	5
Worcester (Mass.) Electric Light Co.	113,800	....	98
York (Pa.) Railways Co. / Edison Light & Power Co., York, Pa. }	32,000	2,500	...
Yonkers (N. Y.) Elec. Light & Power Co.	6,850	....	....
Youngstown (Ohio) Sheet & Tube Co.	3,856,000	155,368	1,000

*$30 per month. †Employees, $75 per month. ‡Employees, $500 per month. ‖$34.50 per month. ¶$125 per month.

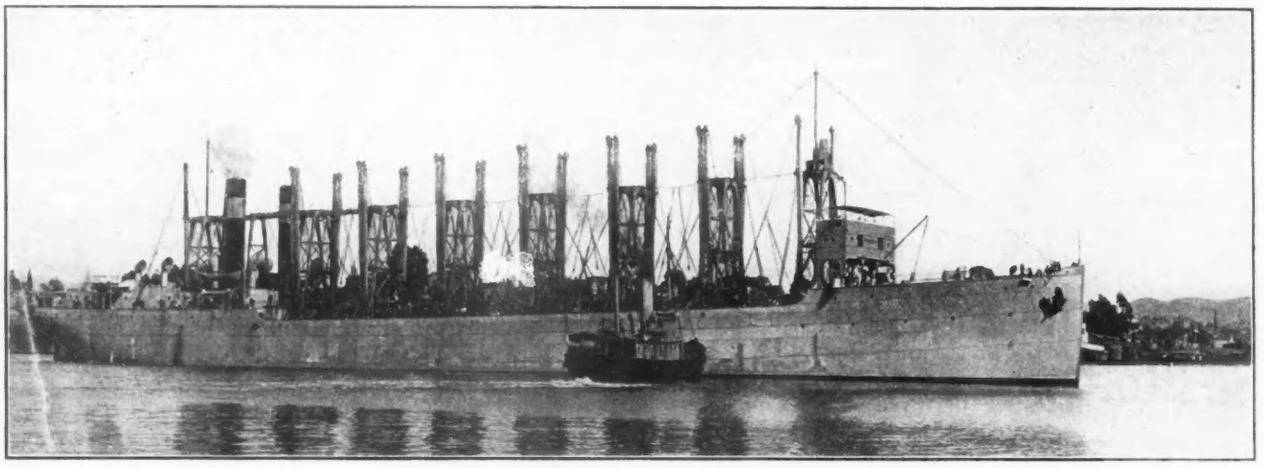
§City division of company has been giving $250 per month to Red Cross.

Electric Ship Propulsion in the Navy

Construction of Electrically Driven Battleships and Battle Cruisers Undertaken with Fullest Confidence in the Step, Says Admiral Griffin—A Summary of the Advantages

REAR ADMIRAL GRIFFIN, chief of the Bureau of Steam Engineering of the Navy Department, is looking forward to the rapid completion of the new battleship New Mexico, now being built at the New York Navy Yard, the first warship in the world, aside from the collier Jupiter, to be electrically driven.

It has been under the direction of Admiral Griffin that the plans for the new battleships and battle cruisers of the United States Navy which are to be electrically driven have been prepared.



THE ELECTRICALLY-DRIVEN U. S. COLLIER JUPITER

The Washington correspondent of the ELECTRICAL WORLD discussed the construction of the new electrically driven ships with Admiral Griffin, and was requested, in accordance with the public policy, not to publish in the ELECTRICAL WORLD any technical details.

"We went into the building of battleships and battle cruisers to be electrically driven only after the most careful consideration and knowledge based on our experience with the machinery of the collier Jupiter," said Admiral Griffin. "We feel the fullest confidence that we are not making a mistake and that the machinery of all these battleships and battle cruisers will prove to be what we want. Some of us steam engineering men are now becoming electrical men. We move with our profession."

An official statement was prepared not long ago in Washington which gave some of the advantages of the electric drive on the larger ships. Admiral Griffin's attention was drawn to it by the Washington correspondent of the ELECTRICAL WORLD, and he said he desired to indorse it. This was the statement:

Electrical propulsion virtually gives duplicate means of propulsion. With two turbines and two motors, one or either of them could break down and still leave a means of propulsion; this is of course true in the case of direct-connected machinery; but in the case of the electric drive, if it is a turbine that is broken down, the propulsion would still be twin-screw. The two turbines would be so designed that either would be capable of giving about seventeen or eighteen knots, and the normal method of running would be with one turbine and two motors. This makes it possible to overhaul the other turbine whether it is at sea or not.

The turbines are always operated under fairly good load conditions and hence always give good economy. Since only one turbine is used at the lower speeds, the load on it will always be twice as much as for direct-connected machinery.

The turbines are always operated under fairly good speed conditions and this insures good economy of the turbines. This is due to the fact that the speed-reduction ratio is variable. This is accomplished by winding the stators of the motors for two different numbers of poles, either of which can be put into operation by simply throwing a switch. For example, if the generator has two poles and the motors are arranged to have either thirty poles or fifty poles, the reduction in the first case would be fifteen to one, and in the second case thirty-five to one.

This combination of good load conditions and high speed is really the vital point, so far as economy at cruising speeds on a battleship is concerned; and it is an advantage that any other form of propulsion will find it difficult to overcome.

The governor absolutely eliminates all racing in a seaway, with the attendant strains on shafting and danger of throwing propeller blades.

Speed can be maintained with much greater accuracy than with any other form of propulsion. This is of little importance to a merchantman; but it is not necessary to emphasize the importance of this to a battleship to anyone who has been in the fleet.

The space taken up is less than required for other forms of propulsion.

The arrangement of the machinery is much more flexible than any other form of propulsion, as the position of turbines and motors is not fixed.

The readiness with which repairs can be effected is an argument.

Owing to the small size of the turbines, the upkeep will be very materially reduced.

The rapidity of operation is much greater than with other forms of propulsion.

After indorsing the above official ideas, which caused the adoption of the electrical propulsion idea for seven battleships and five battle cruisers now being built for the navy, Admiral Griffin said:

"But the biggest advantage has not been stated.

Electric propulsion does not require a separate turbine for backing. You reverse your motor instead of bringing into play a turbine which has been running idle."

While the New Mexico at the New York Navy Yard will soon be completed, the other large new ships of the navy which are being built with the electrical drive are not so well advanced. The Colorado and Washington are being built at the New York Shipbuilding Company's yards, the Maryland and the West Virginia at the Newport News Shipbuilding & Dry Dock Company yards, the Tennessee at the New York Navy Yard and the California at the Mare Island Navy Yard. These are all battleships.

Five battle cruisers are being built, two under contract at the Newport News Shipbuilding & Dry Dock Company yards, one at the Philadelphia Navy Yard, one at the New York Shipbuilding & Dry Dock Company yards, and one at Fall River. These ships will be given names famous in American history.

QUICK ELECTRICAL SERVICE FOR AVIATION FIELD

Dayton Power & Light Company Provides Energy for Wilbur Wright Aviation Base—Engineering Co-operation with Government

The Wilbur Wright aviation field, established by the government as a base for training and instructing aviators for the United States Army, the electrical service for which is being supplied by the Dayton Power & Light Company, is located at Fairfield, Ohio, 9 miles (14.4 km.) northeast of Dayton. The field comprises approximately 2500 acres (6177 hectares), upon which 105 buildings are constructed, twenty-four of which are hangars, each having a capacity for housing six airplanes. The base consists of what are recognized by the government as two units; in other words, there are two separate and distinct sections, identical in every respect, lying adjacent to each other, but in combination they appear as one base.

All of the buildings used as officers' quarters, barracks, hospitals, etc., will be supplied with steam heat, two central heating plants being installed.

In this connection it is interesting to learn that the Dayton Power & Light Company extended the third wire from its Osborn substation to Fairfield, a distance of 1.5 miles (2.4 km.), and from that point erected a quarter-mile (0.4-km.), three-phase, 2300-volt line to the aviation field within forty-eight hours.

This was followed by the erection of a 2-mile (3.2-km.), three-phase, 2300-volt line required by the contractor to place the power service at his disposal at the various buildings under construction. This power service was for the purpose of operating saws, drills, etc., required in the erection of the buildings. This work was accomplished in record time, and it has been admitted that the Dayton Power & Light Company had service available whenever required by the contractor.

Following the completion of this line, primary lines were extended in the rear of the hangars for a distance of 1.5 miles (2.4 km.). As each building was completed the proper transformer was erected to supply service. A total of sixteen transformers were erected for the temporary electric light and power requirements of the contractor.

The transmission line from the Osborn substation soon became taxed to its capacity and a 3-mile (4.8-km.) line from the Dayton-Osborn and New Carlisle transmission line of the Dayton Power & Light Company was erected in about three days in order that sufficient electrical capacity could be supplied.

This latter line when totally completed will be a 40-ft. (12-m.) Class B Idaho cedar pole line, spans 200 ft. (60.9 m.), No. 4 B. & S. hard-drawn stranded bare copper insulated with Ohio Brass Company No. 11,622 and mounted on Lee pins. The voltage of this transmission line is to be 13,200, 60-cycle, three-phase, it being the ultimate intention to increase this to 33,000.

This transmission line terminates in a high-tension substation which houses electrolytic arresters, three 150-kva., 13,200/2300-volt, single-phase, 60-cycle transformers with a 60-kva. regulator. Underground cable is used to connect this substation to the primary line in the rear of the building, at which point it rises to the top of the pole line along which the primary line is routed. All buildings are served by underground cables from this pole lead.

The power load of the field is concentrated at one point in each unit, making it convenient to furnish all power service for each of the two units from one transformer installation.

All power for the field is supplied by two 100-kva., three-phase, 2300-volt to 230-volt transformers. The power demand is made up of water pumping, aero repair, garage, etc., the total load being approximately 200 kva. The light load will approximate 300 kva. All power and light will be supplied by means of eighteen distributing transformers. The high-tension line and substation have been so designed as to provide ample means to double the present electric developments.

The engineers of the Dayton Power & Light Company co-operated and furnished considerable engineering advice.

PROGRESS ON WORK FOR THE HAMPTON ROADS NAVAL BASE

Development of Plans of the Virginia Railway & Power Company for Furnishing the Electrical Service

The following statement showing progress of work done by the Virginia Railway & Power Company for the United States naval operating base at Hampton Roads, Va., has been given to the ELECTRICAL WORLD by J. Carlyle Stephens, electrical engineer of the company:

July 6, 1917.—First request received from the supervising architects for collaboration in ascertaining the requirements of the base and deciding on a general plan of distribution. The company placed its engineering staff at the disposal of the government for this service.

July 17, 1917.—Approved plan in shape to get prices and delivery on material. This plan consisted of a central outdoor substation of approximately 1000-kva. capacity, transforming from 11,000 to 2300 volts, and for the present, three 2300-volt, three-phase distributing circuits.

July 26, 1917.—Authority received for ordering material and having delivery of same placed on war basis.

July 30, 1917.—Company's representative took actual charge of construction work, and work begun.

Aug. 20, 1917.—Large portion of transformer consignment, wire and other material received. Up to this time all poles have been set, and such wire as could be supplied locally put up.

Middle West Is Speeded Up for War

Electrical Companies with Headquarters in Chicago Are Turning Men and Resources to the Service of the Government in Any Direction Where Help Is Needed

IN PROVIDING the fundamentals of war—money, men and materials—the electrical industry in the Middle West has been forward.

Prominent in the work of helping the nation in every way, large or small, is the Commonwealth Edison Company of Chicago. The company has donated the use of the old Edison building, 120 West Adams Street, for the Illinois State Council of Defense and other war bodies.

When the aviator Ruth Law dashed into the State Council of Defense, stating that she had no money with which to light her aeroplane electrically while she was flying in the interests of the government, the Commonwealth company gladly provided the electric sign illumination for the machine. On other occasions quantities as high as two hundred of 200-watt lamps have been supplied to army organizations which needed light immediately and were unable to purchase the desired equipment at once. In common with other companies the company supplied the government with a list of transformers which it could release for cantonment work.

Activities of Officials

Samuel Insull, president Commonwealth Edison Company, Public Service Company of Northern Illinois, Middle West Utilities Company and West Penn Power Company, and prominent in control of many other utility properties, has given and is giving of his time and strength to numerous activities connected with the war.

The powers of the Illinois State Council of Defense, granted by the Legislature, are very broad. The council, under the chairmanship of Samuel Insull, has done much for the Great Lakes naval training station, Great Lakes, Ill., and has taken a leading part in the movement to regulate coal prices in the public interest.

E. W. Lloyd, general contract agent Commonwealth Edison Company, is assistant secretary of the State Council of Defense, and many other officers and department heads are contributing time and effort in furtherance of the work.

Major Peter Junkersfeld has traveled much in the last three months as supervising constructing quartermaster for the sixteen cantonments for the new National Army.

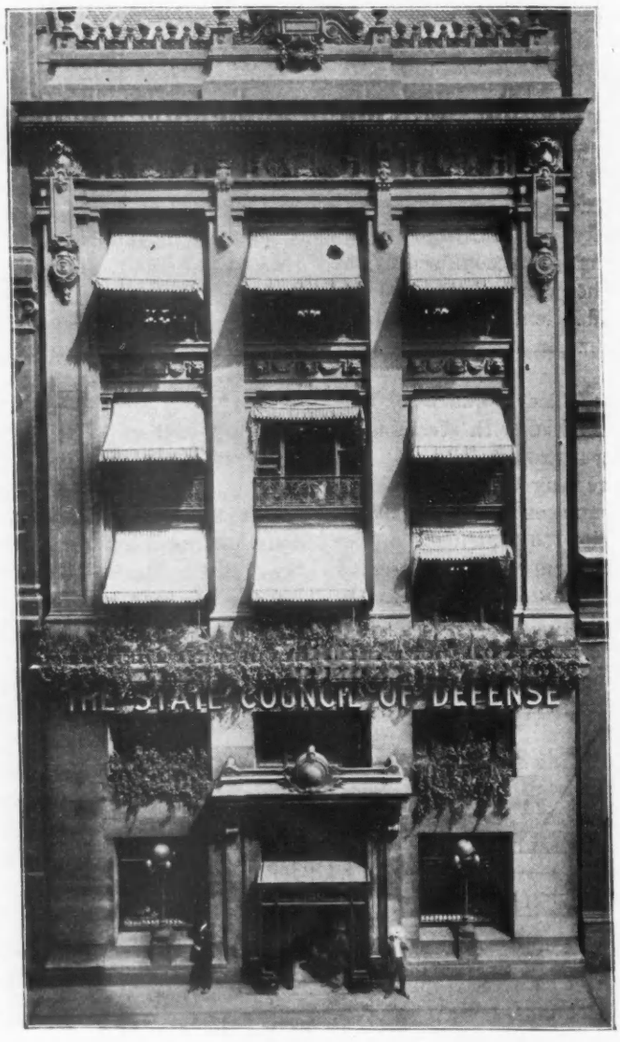
George R. Jones, the Public Service company's purchasing agent, is chairman of the organization known as the "Four Minute Men," which is arranging for talks before moving picture audiences and keeping up enthusiasm in that manner. Keene Richards, formerly the company's superintendent at Lacon, Ill., has been commissioned captain in the Signal Corps.

Help from Byllesby Organization

In the Byllesby organization H. M. Byllesby has been giving a large percentage of his time to co-operative work. George H. Harries, the vice-president of the company, is now a brigadier general in charge of three regiments of the Nebraska National Guard at Deming, N. M. W. R. Thompson, manager of engineering construction, is among those who have joined the Officers' Reserve Corps.

Three properties of the company are furnishing utility service to cantonments.

While meeting these unusual demands at some points, the company is taking constructive measures for conservation at other places.



ILLINOIS STATE COUNCIL OF DEFENSE BUILDING

Service of the Manufacturers

Among the manufacturers the various companies located in different cities are an important factor in government work. They are not only supplying vast quantities of materials but in addition are furnishing large quotas of men for national service in the fighting forces and elsewhere.

In the heating device field the Hughes Electric Heating Company is supplying a steady government demand for army and navy bake ovens. A new type of oven has been developed to meet army conditions.

A BUSY SCENE AT ROCKFORD, ILL.

Typical Work at the Cantonments

Examples of Rapid Necessary Construction by Central Station Companies to Meet the Government Requirements for Troops So that Electric Service Shall Be Ready When It Is Wanted

IN DIFFERENT sections of the country central station companies have handled their forces of men rapidly in order to complete without delay the construction work necessary for providing electric service for the government cantonments. To get the material in time has involved great effort in various cases. Central station officials and employees have worked loyally to do their part. The following examples are presented in the ELECTRICAL WORLD as typical of the patriotic spirit in which the industry has come forward to the national call.

The same attitude of readiness to furnish service is reported throughout the country generally.

WORK HASTENED IN LITTLE ROCK

C. J. Griffith, general manager Little Rock (Ark.) Railway & Electric Company, in writing to the ELECTRICAL WORLD, says:

The Little Rock Railway & Electric Company is constructing a transmission line from its power house to the Twelfth divisional cantonment, located approximately 8 miles from the city.

Prior to the location of this cantonment at Little Rock, the company was furnishing light and power for the officers' reserve training camp at Fort Logan H. Roots, which is on the route of the transmission line to the cantonment. In order that the construction forces of the cantonment might have immediate service, the line was extended from Fort Roots to the cantonment and 2300-volt service furnished to the contractors, James Stewart & Sons, on July 27, their requirements being approximately 100 kw.

The demand at the Twelfth divisional cantonment will approximate 1000 kw., 350 kw. of which will be used for pumping purposes, and the remainder for lighting and miscellaneous power purposes. The 13,200-volt line mentioned above will be of sufficient capacity to care for Fort Roots and a number of large power consumers in this vicinity, these amounting to about 750 kw.

The transformers for this work are being furnished by the Wagner Electric Manufacturing Company, St. Louis, and consist of three 750-kva., three 350-kva., three 200-kva. and three 100-kva. This does not include the distribution transformers at the cantonment. The three 200-kva. transformers will take care of the demand of the existing customers on this line. The poles were purchased from the Page & Hill Company, Minneapolis; the wire from the Phillips Insulated Wire Company and John A. Roebling's Sons Company; insulators from the Ohio Brass Company and Parker Insulator Company, and the switching and lightning protective devices from the General Electric Company.

The contract for furnishing light and power to the cantonment was closed on July 8, and it has been a herculean task to assemble the necessary material and apparatus.

BRIGADIER-GENERAL HARRIES CALLS FOR PERSONAL SELF-SACRIFICE

CAMP CODY, DEMING, N. M.,
Aug. 27, 1917.

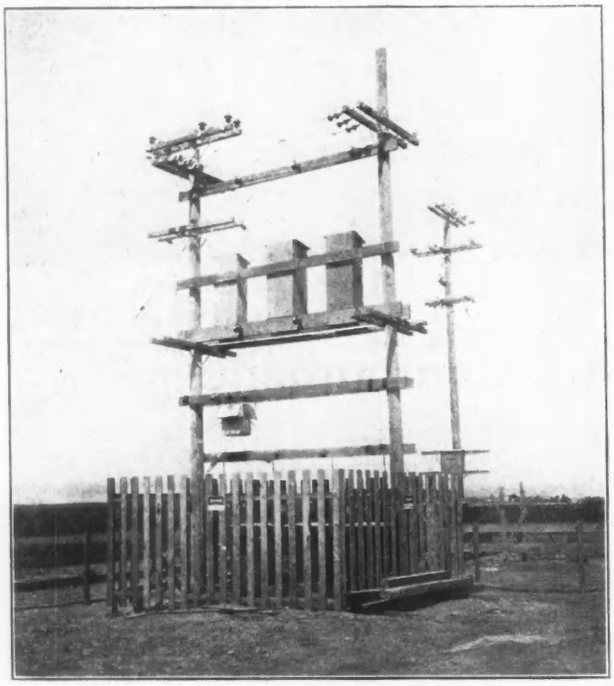
To the ELECTRICAL WORLD:

Surrounding conditions, with their insistent demands, render impossible any well-balanced thought of matters other than the imperative military duty of the hour. To suggest any one great national service thing which could be undertaken by the electrical industry of the country is beyond me. What can be done, though, by every man, woman and corporation in the business is to give (to the last measure of human and mechanical energy) unselfish loyalty and whole-hearted endeavor in every practicable phase of that personal self-sacrifice without which our existence as a free people cannot be justified. GEO. H. HARRIES.

WORK OF THE SAN DIEGO COMPANY

L. M. Klauber, superintendent electric department San Diego (Cal.) Consolidated Gas & Electric Company, sends the following description of the work at Camp Kearny to the ELECTRICAL WORLD:

Camp Kearny, is located on a tableland east of Linda Vista station on the Atchison, Topeka & Santa Fé Railway from San Diego to Los Angeles, and about 14 miles north of the business district of the city of San Diego. Here there is a large level tract of land covering approximately 8000 acres, (3237.5 hectares) known as the Linda Vista Mesa. The camp site, though located only 6 miles (9.7 km.) from the shore of the Pacific, is at a considerable elevation,



SUBSTATION SERVING CANTONMENT

no portion of it being situated below the 425-ft. (129.5-m.) contour.

From the time the location of the National Guard cantonment was given out, there was some delay before contracts were awarded and actual construction begun. Nevertheless, the San Diego Consolidated Gas & Electric Company began construction work immediately and continued it throughout this period, so that when the general contractor began work electric energy was available on the site for lighting and power; and gas for cooking within a few days after the contractors' forces began to erect the temporary buildings for their own accommodation.

The San Diego company tapped one of its main 11,000-volt feeders at the south side of Mission Valley, which is north of San Diego, and erected 10.5 miles (16.9 km.) of three-phase 11,000-volt circuit to the camp site. The conductor is No. 4 bare, the pole spacing on tangents being 350 ft. (106.7 m.); 110 50-ft. (15.2-m.) poles and fifty-five 40-ft. (12.2-m.) poles were set for this line. The 50-ft. (15.2-m.) poles were used along a portion of the line which will in future be occupied by one of the company's 66-kv. transmission lines. Digging on this line was rather difficult; across the mesa lands every hole must be blasted in hard pan.

While the electric extension was being run the gas department installed 9 miles (14.4 km.) of 6-in. (15.2-cm.) high-pressure gas main, the joints being welded.

At the camp site we have a temporary substation stepping down from 11,000 to 2300 volts. This has a capacity of 300 kva. and will be added to from time to time as may be required.

The company has been awarded the contract for the distribution system on the camp site. This will involve approximately 11 miles (17.7 km.) of pole line carrying various 2300-volt secondary and street-lighting circuits. The main primary feeders will be three-phase No. 2 medium hard-drawn double-braid weather-proof. Secondary circuits will vary from No. 6 to No. 2 wire. Street-lighting circuits will be 0.25-in. (6.4-mm.) galvanized steel. About 400 poles will be set on the camp site, mostly 40 ft. and 30 ft. (12.2 and 9.1 m.). Main lines will be jointly used with the communication companies. Street lights will be 100 cp. 6.6 amp. Mazda C units, mounted on 4-ft. (1.2-m.) arms. Approximately 350 will be installed.

Temporary business during the construction period which has been so far connected includes 50 hp. at a sawmill, a 40-hp. air compressor, a 10-hp. hoist at a reservoir and two 5-hp. portable saws. More of the latter will be added as construction proceeds. All of the contractors' camp buildings are electrically lighted, as well as the temporary military camps about the site. There are two moving picture shows in operation.

The total permanent connected load has not yet been definitely decided. There will be approximately 190 hp. of pumps at the cantonment site, and the city of San Diego will have a booster pump located some 6 miles (9.7 km.) south of the site, with a 100-hp. motor. The total lighting load will be in the neighborhood of 450 kw.

The company now has about 120 men employed in the gas and electric distribution systems being installed on the camp site. The company camp is located on the south edge of the site at a considerable distance from the other contractors' camps. Material is delivered by railroad, the Santa Fé having extended its lines within a few days after the arrival of the contractor.

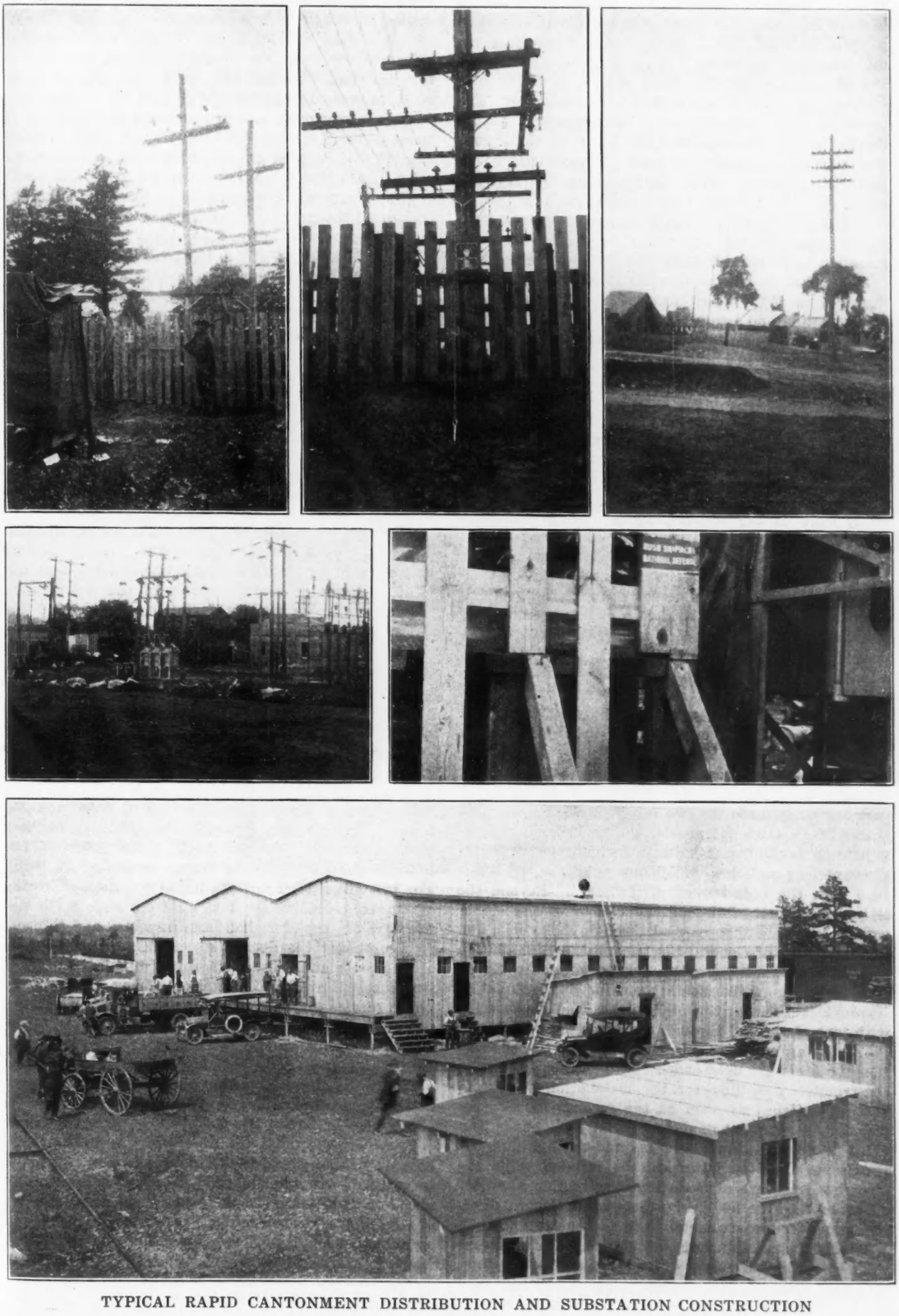
We have had no difficulty in securing adequate labor locally. Material, both for the construction of our line to the cantonment site and for the construction of the distribution system for the government, has been drawn from our local stock, so that there has been no delay. Poles, crossarms, transformers, wire and hardware were available in adequate quantities.

RAPID ELECTRICAL CONSTRUCTION AT AYER CANTONMENT

Soon after this issue of the ELECTRICAL WORLD reaches its readers, the United States army cantonment at Ayer, Mass., will be in active occupancy by the first levy of drafted troops to be concentrated in the Northeast for preliminary training prior to overseas service. Electricity has been a vital factor in the construction of this cantonment, officially known as Camp Devens, and it will play an equally useful part in the life of the camp during the training periods.

To furnish a permanent electrical supply it was necessary to build a 66,000-volt transmission line 8.2 miles (13.1 km.) long from Leominster, Mass., to the cantonment, and this task was performed, including the design and erection in part of a permanent substation, in one month and fourteen days. The work was done by the Power Construction Company, Worcester, Mass., affiliated with the New England Power Company, which supplies energy for all the permanent electrical service of the cantonment, the Ayer Electric Light Company acting as distributer of electrical energy for construction service only.

An article describing the use of electricity at Camp Devens was published in the ELECTRICAL WORLD for July 28, 1917, page 171. Before emphasizing the permanent substation and line work which has been completed since that date, attention may be called to the temporary substation erected near the southeast corner of the camp for construction service. At this point three 100-kva. General Electric transformers were installed within a stockade to reduce the pressure from



TYPICAL RAPID CANTONMENT DISTRIBUTION AND SUBSTATION CONSTRUCTION

12,000 to 2300 volts for local distribution. This service is taken from the New England Power Company system at Clinton, Mass., by a single-circuit, three-phase tap into a local transmission line running between Clinton and Ayer village, the connection being made in the town of Harvard about 5 miles (8 km.) from Ayer. The incoming line terminates on a wooden-pole structure erected within the stockade, and a set of choke coils and horn-gap lightning arresters is mounted on the overhead structure. From the incoming line taps are taken through disconnecting switches to a set of oil switches controlling the supply of energy to the transformer bank, and by the use of long cross-arm construction the 2300-volt leads are easily cared for and carried away to the various distributing centers. A distant view of the transformer stockade with a typical 2300-volt line and two sets of Westinghouse lightning arresters of the pole type used in the camp distribution service is shown in an accompanying illustration.

Cantonment Will Contain 1118 Buildings

The cantonment will accommodate more than 40,000 troops when present construction work is completed and will contain 1118 buildings, of which 622 are scheduled for completion by Sept. 1. At this writing 7500 men are at work on the cantonment, the general contractors being Fred T. Ley & Company of Springfield, Mass. The permanent electrical supply is distributed from a semi-outdoor substation. As it was impossible to obtain outdoor transformers of the size needed in time, it was necessary to provide for housing the available units, and these are installed in a structure of wooden studding and asbestos-coated walls. Besides the outdoor line terminal facilities, which include General Electric K026 66,000-volt oil switches and aluminum cell lightning arresters, the plant contains a 20-ft. by 28-ft. (6-m. by 8.5-m.) regulator and oil-switch house from which leads are carried to a distributing frame on the south side of the substation, from which the various 2300-volt lines lead to different parts of the camp.

Provision is made for two incoming 66,000-volt lines spaced 36 ft. (10.9 m.) apart. The incoming leads terminate on Locke five-disk strain insulators attached to disconnecting switches, which are connected by short taps with the high-tension oil switches. Beyond the latter another set of disconnects is provided and the incoming leads are then carried through choke coils and an installation of General Electric outdoor high-tension metering equipment located just outside the transformer house. A horizontal transfer bus installation is provided between the oil switches and choke coils, with taps at the end through disconnecting switches to the lightning arresters. In the middle of the bus section the leads are dead-ended on strain insulators, the construction providing for the installation of disconnecting switches as soon as the second line is completed. An extra set of disconnecting switches is provided between the horizontal bus and the lightning arresters so that the latter can be isolated while the incoming leads are alive during construction or under operation. Three 500-kva. water-cooled General Electric transformers are installed in the substation.

The line installation from Leominster to Camp Devens when complete will consist of two independent pole lines equipped with Thomas wishbone type cross-arms and Locke suspension insulators. The two lines will be spaced 40 ft. (12 m.) apart on a right-of-way 125 ft. (38 m.) wide, and about 600 40-ft. (12-m.) chestnut poles are required. On straight line four-disk insulators are used, five-disk units being provided on dead-ends. A standard spacing of 6 ft. (1.8 m.) between conductors is employed, and one complete transposition is made in the 8.2 miles (13.2 km.) run. This is easily effected by reversing the wishbone arms at succeeding poles. Each pole is equipped with a 7/16-in. (12-mm.) steel guy wire which grounds the wishbone arm at the bottom of the pole. The average span is 200 ft. (60 m.). The line wire is No. 2 copper.

The Camp Devens line is tapped into the 66,000-volt lines of the New England Power Company outside the substation of the Leominster Electric Light & Power Company, which is fed by two branch lines tapping the Fitchburg-Clinton lines of the system about 2 miles (3.2 km.) away. The high-tension oil switches at Camp Devens are of the manually operated type, equipped with 12-volt direct-current trip coils. The direct-current supply is derived from a set of small storage batteries which are frequently charged at a local garage.

To complete the line construction by Aug. 20, the date required by the government, the Power Construction Company concentrated its entire staff upon the task. Work was begun on July 5, orders being placed for line and substation equipment and designs started. The substation was made alive on Aug. 19. The utmost co-operation by manufacturers was sought and obtained. Personal representatives of the construction company went to various factories, stayed with the orders while the manufacturers were handling them, and inspected the product as rapidly as possible, in some cases accompanying shipments to Massachusetts. Lighter material was sent by express and heavier material was rushed through by fast freight on account of its military importance. The label used on an oil-switch shipment is shown in one of the illustrations.

Rapid Handling of Materials

In a single day an entire carload of poles was unloaded and distributed from Shirley, Mass., a halfway point between Ayer and North Leominster on the Fitchburg division of the Boston & Maine Railroad. The inspection of insulators began five days after the order was placed at the Locke factory and in twenty-five days all insulators had been inspected and shipped. At Leominster the line construction crew placed some of the wishbone cross-arms forty minutes after the train arrived at the local station. Long-distance telephone service played a most important part in rushing the work. The substation switchboard, an eleven-panel outfit, was built by the Westinghouse company at its East Pittsburgh factory in four weeks. About 100 orders were placed in connection with the substation material, and a maximum force of thirty men was employed on this part of the work.

From start to finish the work was given the preference over other production and construction tasks, and in completing the installation of actual service a day ahead of the time set by the government, the engineers of the Power Construction Company, the operating organization of the New England Power Company, manufacturers and transportation interests achieved a distinct patriotic service.

Meeting the Nation's War Telephone Needs

Bell System Responds to the Supreme Call for Efficiency— Resources Placed Promptly at the Disposal of the Government and Enlarged Rapidly

LONG before the United States severed diplomatic relations with Germany the American Telephone & Telegraph Company had established harmonious and effective methods of co-operation with the government to meet the anticipated requirements for wire communication. A year ago, working with the Navy Department, telephone officials planned and carried out a three days' mobilization of communication forces, during which war conditions were simulated.

Instantaneous communication was provided over the wires of the Bell system by both telephone and telegraph from the office of the Secretary of the Navy at Washington to all the naval stations in the continental United States, and telephone communication was maintained between the office of the Secretary of the Navy and a battleship in the Atlantic Ocean.

Immediately upon the rupture of diplomatic relations with Germany the officials of the Bell system got in close touch with the Council of National Defense, the president of the War College, the chief signal officer of the army and the director of naval communication and other officials of the Department of the Navy.

MAJOR JOHN J. CARTY

Chief Engineer American Telephone & Telegraph Company, Now in Active Service in the Signal Corps, U. S. A.

Plans for co-operation were established, and as a result, notwithstanding the extraordinary demands for communication, all the requirements of the government are being met satisfactorily.

In accordance with these plans, throughout the Bell system in every part of the United States, all government toll calls were given immediate precedence over commercial business. To give this special service to the government required the special drilling of 12,000 long-line operators in all parts of the country.

About 10,000 miles (16,093 km.) of wire have already been taken from commercial use and turned over exclusively to the service of the Navy, War, Agricultural and other departments for special wire service in connection with the national emergency.

The national capital now has twice as many long-distance toll lines as before the war, and when all the additions to its telephone facilities now under way are completed, Washington will have 500 long-distance wires radiating to every part of the country, with proportionate increases in toll switchboards and operating forces.

Work on a new underground cable from Washington to New York is now well under way, notwithstanding the difficulties in obtaining raw material which have been met and overcome by engineers and scientists. This cable will contain 80,000 miles (128,747 km.) of wire and will be a valuable addition to the existing underground system which provides the national capital with all-underground communication with Baltimore, Wilmington, Philadelphia, Trenton, Newark, New York, Bridgeport, New Haven, Hartford, Providence and Boston. All these points are the centers of extraordinary activity in the manufacture and supply of munitions and war materials of all kinds.

Owing to recent progress in long-distance transmission, the government at Washington has good telephone service with the headquarters of every army department and naval district in the United States and all centers of extraordinary activity in the manufacture and supply of munitions and war materials, and these telephone facilities are being constantly increased.

A comprehensive study of the telephone traffic of the country indicates that still further increase in these facilities will be required to meet the anticipated needs of the army and navy and the general requirements of the war business of the country. Some indication of the extent of these requirements is shown by the fact that on all the main wire routes centering in Washington the growth in telephone traffic during the last few months has been greater than the entire growth during the preceding eight years.

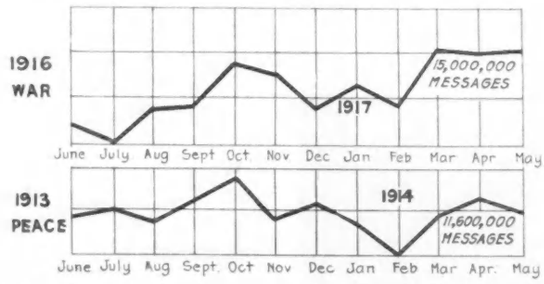
Work is being pushed actively on large additions to the local switchboard facilities at Washington, and large increases have been made in the operating forces.

The government's private branch exchange facilities

have been largely augmented. Where it has appeared that existing switchboard facilities might prove inadequate, new switchboards or large additions to existing boards have been engineered and installed for various government departments.

WORK THROUGHOUT THE COUNTRY

To anticipate every possible need of the government for service has required a vast amount of work, not



LONG-DISTANCE TELEPHONE TRAFFIC—BEFORE AND AFTER THE RECOGNITION OF A STATE OF WAR

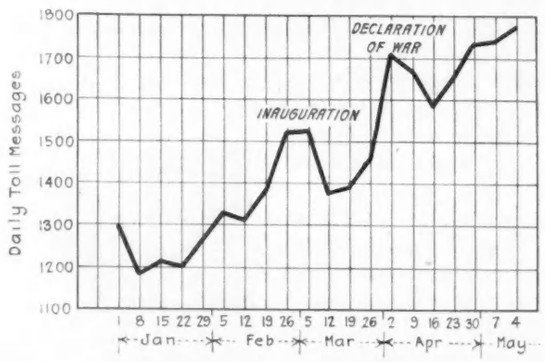
only in Washington but in many other parts of the country. The toll-line situation throughout the Bell system has been checked in detail and every provision made to meet adequately a large increase in the government's requirements for communication between the various army headquarters, state capitols, the various army posts, and the national and state mobilization camps in each department, and the work has already been started.

Existing telephone plants at all the important army posts, navy yards, etc., have been increased greatly, switchboard positions added, cable plant increased and station equipment augmented to meet increased activities. Additional plant has been furnished for reserve officers' training camps and for the enlarged units of the regular army.

The thirty-two cantonments in different parts of the country, now in process of construction, already require a large amount of telephone equipment. When occupied by the National Army it will be necessary to maintain telephone systems which will call for hundreds of positions of switchboards, a large amount of outside plant, and equipment for thousands of stations. It will also be necessary to make considerable additions to the local telephone plants in nearby cities or towns and to increase greatly the number of toll lines.

It is expected that about 40,000 men will be trained at each one of these camps, and this means practically the establishment of a new city of 40,000 inhabitants, for which complete telephone service, both local and toll, must be provided, not only for military purposes of the camp, but also personal needs of officers and men.

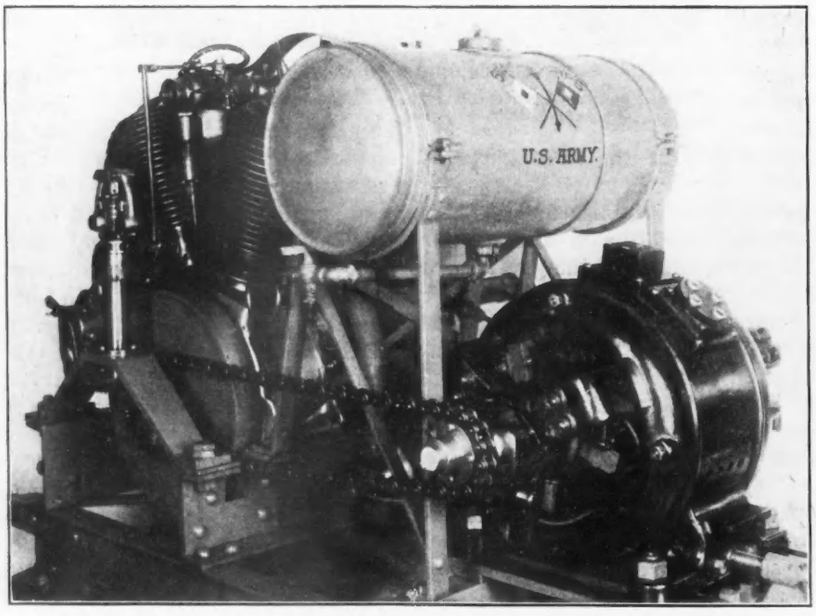
This has required detailed studies, involving many important engineering problems. The work of providing switchboards, loading coils, cables and other material in vast quantities is practically completed. In most cases these camps are located several miles from the nearest city and it has been necessary to provide long lengths of cable containing from 50 to 100 pairs of wires for trunking purposes. Temporary switchboards and trunking facilities have been provided for government officials and contractors during the construction period.



DAILY GROWTH OF TOLL AND LONG-DISTANCE CALLS IN WASHINGTON, D. C., UNDER WAR CONDITIONS

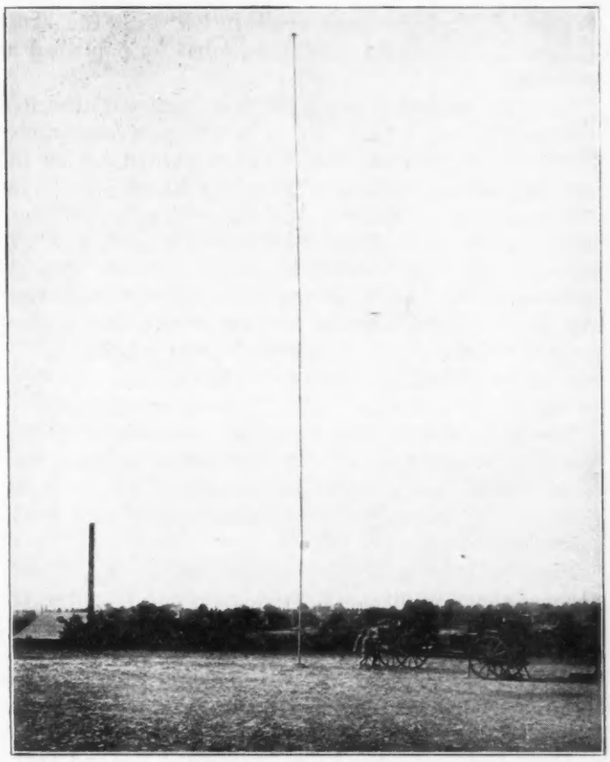
Telephone facilities have also been provided for smaller training camps throughout the country, such as officers' reserve, recruiting and signal corps camps.

The exigencies of war have required a reorganization and enlargement of the United States Coast Guard telephone system, and in this work the Bell system engineers have been giving great assistance. The plans call for providing telephone connections at approximately 100 lighthouses and 200 coast guard stations, the laying of about 300 miles (483 km.) of submarine cable, construction of over 650 miles (1046 km.) of pole line and stringing over 1200 miles (1931 km.) of wire. To connect the Coast Guard system with the Bell system and to provide the quality of service required has made it necessary for the associated companies of the Bell system to add largely to their own plants.

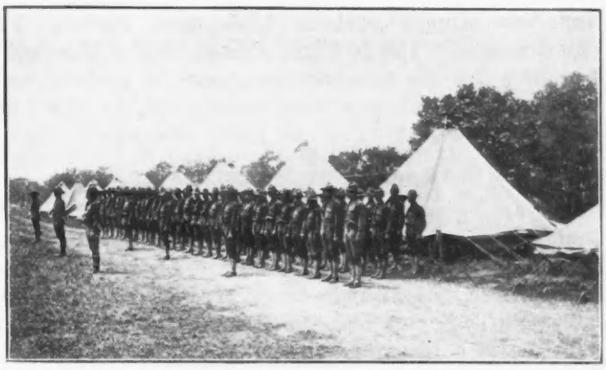


RADIO SKID SET—2-KW. ENGINE AND ALTERNATOR

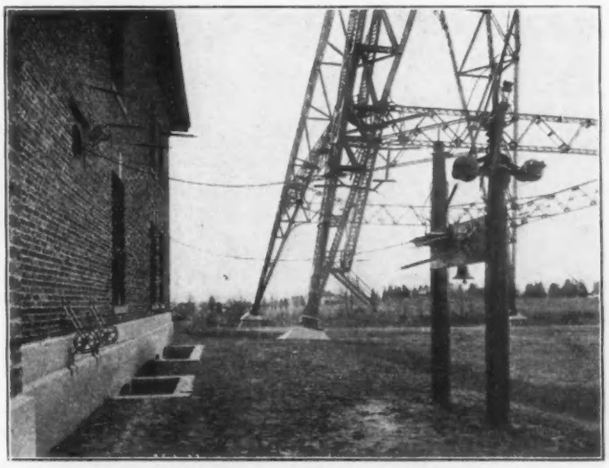
All over the country, important railroad points, bridges



RADIO-TELEGRAPHY HAS A LARGE PART IN THE SUCCESS OF MILITARY MOVEMENTS—MAST OF 2-KW. WIRELESS WAGON USED IN GOVERNMENT SERVICE

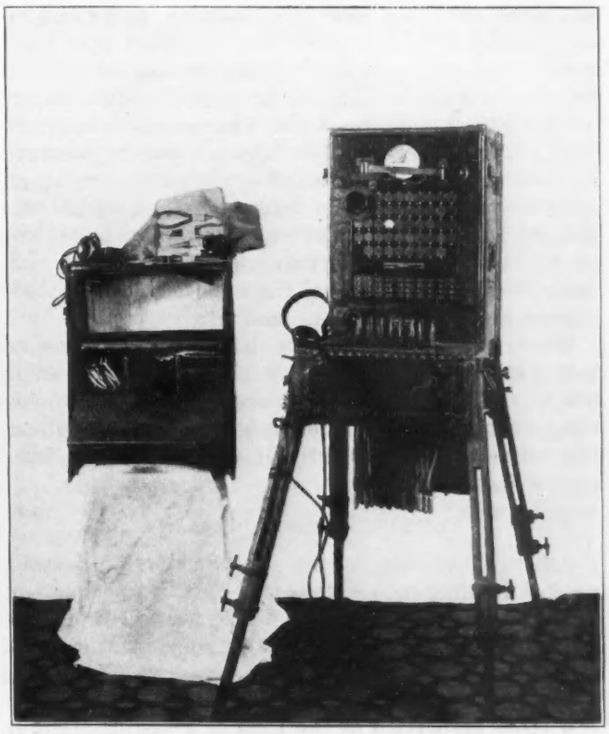


ONE OF FOUR COMPANIES OF SIGNAL CORPS MEN FROM BELL SYSTEM LINED UP AT MONMOUTH PARK (N. J.) CAMP



BASE OF A RADIO TOWER

KEEPING IN CONSTANT COMMUNICATION WITH ALLIED FORCES, THE MILITARY COMMANDER IS HELPED BY WIRELESS—RADIO TRACTOR ERECTING 60-FT. MAST



CAMP TELEPHONE SWITCHBOARD

and water-supply systems have been guarded by detachments of the National Guard, and it has been necessary for the telephone companies to provide special equipment at important points and facilities of communication between those points and headquarters.

SIGNAL CORPS ENLISTMENTS

By arrangement with the Signal Corps, United States Army, fourteen battalions of the Signal Corps, United States Reserves, have been organized throughout the Bell system and certain specially trained men have also been detached from company service to the naval coast defense and to the navy. More than 150 have been admitted to the officers' training camps.

The majority of units of the Signal Corps have been recruited to practically full strength and nearly all the officers have received commissions. Several battalions

LEARNING HOW TO SERVE THE GOVERNMENT

have been ordered into camp at various locations and are now receiving intensive training under regular army officers. Other units, not yet called into active service, are drilling and attending lectures and conferences conducted by regular army and militia officers.

About 2500 men have thus been enrolled. Besides this, approximately 2000 Bell employees are members of the National Guard and the Naval Militia or are otherwise under oath to present themselves when called, making a total of over 4600 Bell employees who are now or will be in the near future in military service, or more than 10 per cent of the male employees of the system between twenty-one and thirty years.

Many Bell employees now in military service are technically trained men whose places cannot be easily filled, yet the system has encouraged employees to join the government fighting forces and has striven to meet the extraordinary demands for service and the depletion of its effective staffs.

INCREASED TRAFFIC DEMANDS

An excellent idea of the increased traffic demands upon the Bell system is indicated by the accompanying diagram showing that peace traffic for twelve months before the war meant 11,600,000 long-distance messages, while in 1916 the long-distance messages aggregated over 15,000,000.

A large proportion of the time of scientific staffs of the Bell system and its laboratories has been devoted to special work in close co-operation with the army and navy, the nature of which cannot be published at this time.

In addition to these vast telephone activities the Bell system has been notably active in aiding in other directions. In accordance with the plan worked out by the company 54,160 employees have purchased on the installment plan $3,850,800 Liberty bonds; in addition, the company itself subscribed for $5,000,000, and officers and employees have taken large amounts through other agencies. Many of the officials spent much time and effort in working for success of the loan. They have also been active in the Red Cross campaign, the company contributing $500,000. Money has also been raised in the organization for several ambulances.

The Bell system has also aided directly and indirectly through its employees in such movements as those concerned with food conservation, national or state defense, draft registration, hospital units and other patriotic services.

The construction program of the Bell system, to provide for the extraordinary commercial and manufacturing activity created in this country by the European war, is the greatest in the history of the telephone business; yet shortage of material and difficulties in obtaining labor and transportation have been so imperative that it has been necessary to divert telephone material and apparatus from commercial use and apply them exclusively to government service. It seems inevitable that still larger amounts of material and apparatus must be so applied in order to meet the constantly increasing requirements.

Under such conditions it will require the conservation of every resource of the Bell system and co-operation by the telephone-using public to cope with a situation unprecedented in the nation's history and bound to grow more imperative as time goes on.

Work of the Underwriters' Laboratories

Co-operating with the Bureau of Steam Engineering of the navy and with the manufacturers of rubber-covered wire, the services of the Underwriters' Laboratories, Inc., have been used in connection with the examination, testing and labeling at factories of more than 1,000,000 ft. (304,800 m.) of No. 14 gage duplex lead cable for use on submarine chasers. The bureau's specifications for this material require that it be labeled. Special attention has been given to the test performance of all of this material at the several factories which participated in the delivery of the entire amount to the navy.

The Laboratories registered last April for war service with the Bureau of Standards, the National Research Council and the Navy Department. Materials and appliances bearing the labels of the Underwriters' Laboratories are being specified as munitions, and some of the institution's force is at present engaged in inspections and tests of such materials. In a letter to the staff President Merrill said: "All officers and employees will appreciate the vital importance of registering 100 per cent efficiency in our service on war munitions. There must be no failure in field service or on shipboard of any device, material or appliance examined, tested and passed by us."

Co-ordinating Colleges and Government

Educational Section of the Committee on Engineering and Education of the Advisory Commission of the Council of National Defense Does a Necessary Work

CO-ORDINATION of the work of colleges with the government policy in connection with war has been facilitated by the committee on engineering and education of the Advisory Commission of the Council of National Defense, of which Dr. Hollis Godfrey, president Drexel Institute, Philadelphia, is the chairman.

The educational section of this committee was created on May 5, when Dr. Godfrey called together college presidents for a conference in Washington. The conference and the committee which was formed as a result of it made certain general pronouncements on the policy to be pursued by higher institutions during the war.

A statement of the principles that were adopted at this meeting follows:

STATEMENT OF PRINCIPLES

It is our judgment that our colleges and universities should so organize their work that in all directions they may be of the greatest possible usefulness to the country in its present crisis.

We therefore believe, first, that all young men below the age of liability to the selective draft and those not recommended for special service who can avail themselves of the opportunities offered by our colleges should be urged so to do in order that they may be able to render the most effective service both during the full period of the war and in the trying times which will follow its close.

We believe, second, that all colleges and universities should so modify their calendars and curricula as will most fully subserve the present needs of the nation and utilize most profitably the time of the students and the institutional plant, force and equipment. With this end in view, we suggest that, as an emergency measure, the colleges consider the advisability of dividing the college year into four quarters of approximately twelve weeks each, and that, where necessary, courses be repeated at least once a year so that the college course may be best adapted to the needs of food production.

We believe, third, that in view of the supreme importance of applied science in the present war, students pursuing technical courses, such as medicine, agriculture and engineering, are rendering, or are to render, through the continuance of their training, services more valuable and efficient than if they were to enroll in military or naval service at once.

We believe, fourth, that the government should provide or encourage military training for all young men in college by retired officers of the army and national guard or by other persons competent to give military instruction, and that the colleges should include as a part of their course of study teaching in military science, in accordance with the provisions of the national defense act of June, 1916.

We believe, fifth, that the Bureau of Education of the Department of the Interior and the States Relations Service of the Department of Agriculture, with the co-operation of the committee on science, engineering and education of the Advisory Commission of the Council of National Defense, should be the medium of communication between the federal departments and the higher educational institutions of the country.

Finally, we believe that an educational responsibility rests on the institutions of higher learning to disseminate correct information concerning the issues involved in the war and to interpret its meaning.

At subsequent meetings the committee considered the very pressing questions of military training and the arrangements which might be made between the War Department and the colleges.

The committee has pursued vigorously the task of focusing public attention on the desirability of keeping higher institutions in full operation in order that the supply of trained men might not be cut off during the war. It has secured statements from the Commissioner of Education, the Secretary of War and the President. There is now a general recognition of the importance of preserving as nearly intact as possible the system of higher training.

In order to bring a still greater weight of influence to bear on these two fundamental questions the committee held a conference lasting three days with a commission representing the universities of Canada. The Canadian representatives gave the American committee a full account of the way in which the war has affected Canadian universities and of the contributions which these institutions have made to successful prosecution of the war. A document giving a summary of this conference will be issued soon.

At one meeting the thought was expressed that many of the questions coming before the section concerned secondary schools almost as intimately as higher institutions. As it was felt that the section should consequently have the constant advice of a representative group of school officers, an advisory committee with respect to secondary school problems was therefore appointed.

TENDERS OF EXPERT OFFICES

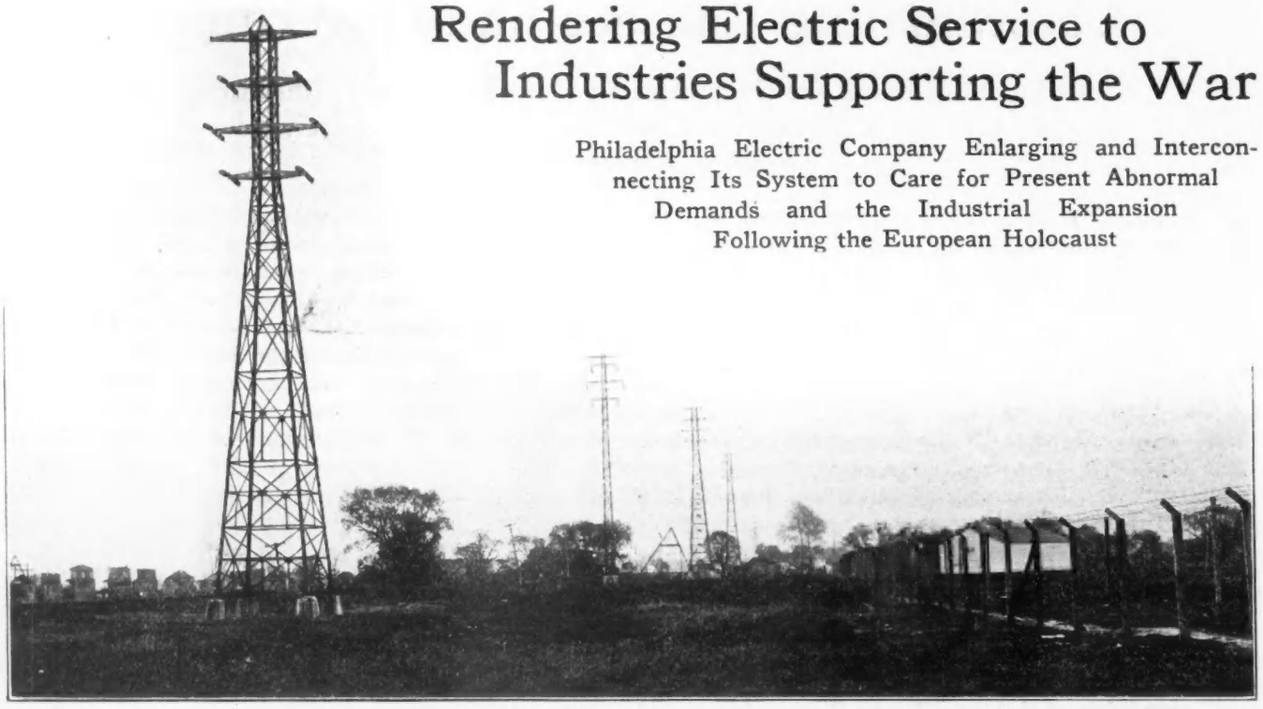
Many persons of highly expert qualifications have tendered their services to the government through the chairman of the section. As the section lacked facilities for undertaking the task of considering such offers carefully and referring them to the appropriate operating departments, it brought the matter to the attention of the Intercollegiate Intelligence Bureau, a voluntary organization under the chairmanship of Dean William McClellan of the University of Pennsylvania. This bureau expressed its readiness to co-operate with the section and agreed to take over all offers of services and to inform the Civil Service Commission, the War Department and other government agencies of the qualifications and residences of persons fitted to perform special tasks.

A detailed reply from the War Department to an inquiry by the section on the subject of military needs of the colleges has been received.

In the judgment of the committee the actual details of changes in curricula have been from the beginning the most important and complicated question with which it had set itself to deal. A sub-committee was appointed in July to take up the question of the possible modification of the course of study in engineering schools. This committee has been at work for several weeks and will report at the beginning of the academic year.

Rendering Electric Service to Industries Supporting the War

Philadelphia Electric Company Enlarging and Interconnecting Its System to Care for Present Abnormal Demands and the Industrial Expansion Following the European Holocaust



FACING unprecedented demands for electric power, due primarily to the great amount of government work being contracted for in and around Philadelphia, the Philadelphia Electric Company has been making extraordinary effort to install the necessary generating and distribution equipment to serve the normal as well as the abnormal loads thrust upon it.

TABLE I—WAR LOAD ON PHILADELPHIA ELECTRIC COMPANY'S LINES

GROUP	No.	INDUSTRIES	TOTALS	
			Power, Hp.	Light, Kw.
A	16	Munitions and arsenals	34,767	60
B	16	Buildings—armories, Mint, Custom House, hospitals and Post Office	656	29
C	20	Chemicals, dyes, soaps, and air products	7,441	306
D	8	Drugs and medicines	722	21
E	79	Equipment: Clothing, shoes, flags, tents, leather and paper	6,256	267
F	10	Foodstuffs	2,870	61
G	12	Shipbuilders and marine machinery	8,044	43
H	6	Batteries, searchlights and other electrical apparatus	1,128	252
I	40	Iron, brass, steel and other metal products	8,633	177
J	14	Machine shops	1,069	15
K	6	Oil and paint	268	34
L	3	Lumber	56	
M	29	Miscellaneous	1,912	5
	259		73,872	1,270

In view of the great shortage of material and of labor this task is not only an exceedingly difficult one, but it is also expensive to the point of causing real concern. While the company is not called upon to furnish any energy for cantonments, it is now supplying approximately 75,000 hp. to industries engaged in government work, including shipyards, munition plants and works of various kinds manufacturing clothing, shoes, chemicals, steel and many other supplies. This load necessitates the building of line extensions, industrial substations and larger feeders, as well as the erection of a new waterside station at Chester, Pa., in time for this winter's peak load.

The territory between Philadelphia and Chester is rapidly developing into one of the most important manufacturing districts in the country, and the electric power requirements are exceedingly large. The new generating station now building in Chester will have an ultimate capacity of 120,000 kw. and will be tied in with the Schuylkill waterside station, the main generating station of the Philadelphia system, by a high-tension transmission line. This line, which is already in operation, is 14 miles (22.6 km.) long and is made up of two three-phase, 66,000-volt circuits, each of which is capable of transmitting 30,000 kw.

Meanwhile the demand for electric energy within Philadelphia is such that the company has under contemplation the erection of another huge station in Philadelphia similar to the one now being erected at Chester. Of course, the company would not undertake such a large outlay at this time unless it was certain that the unprecedented industrial expansion now taking place in the vicinity of its system will continue after the war. Gigantic new shipbuilding plants are being erected by the government and by private individuals along the Delaware River, as well as large industrial works, including the new factories of the Westinghouse Electric & Manufacturing Company at Essington. Table I shows a list of industries now engaged on government work fed from the circuits of the Philadelphia Electric Company.

66,000-VOLT TRANSMISSION LINE

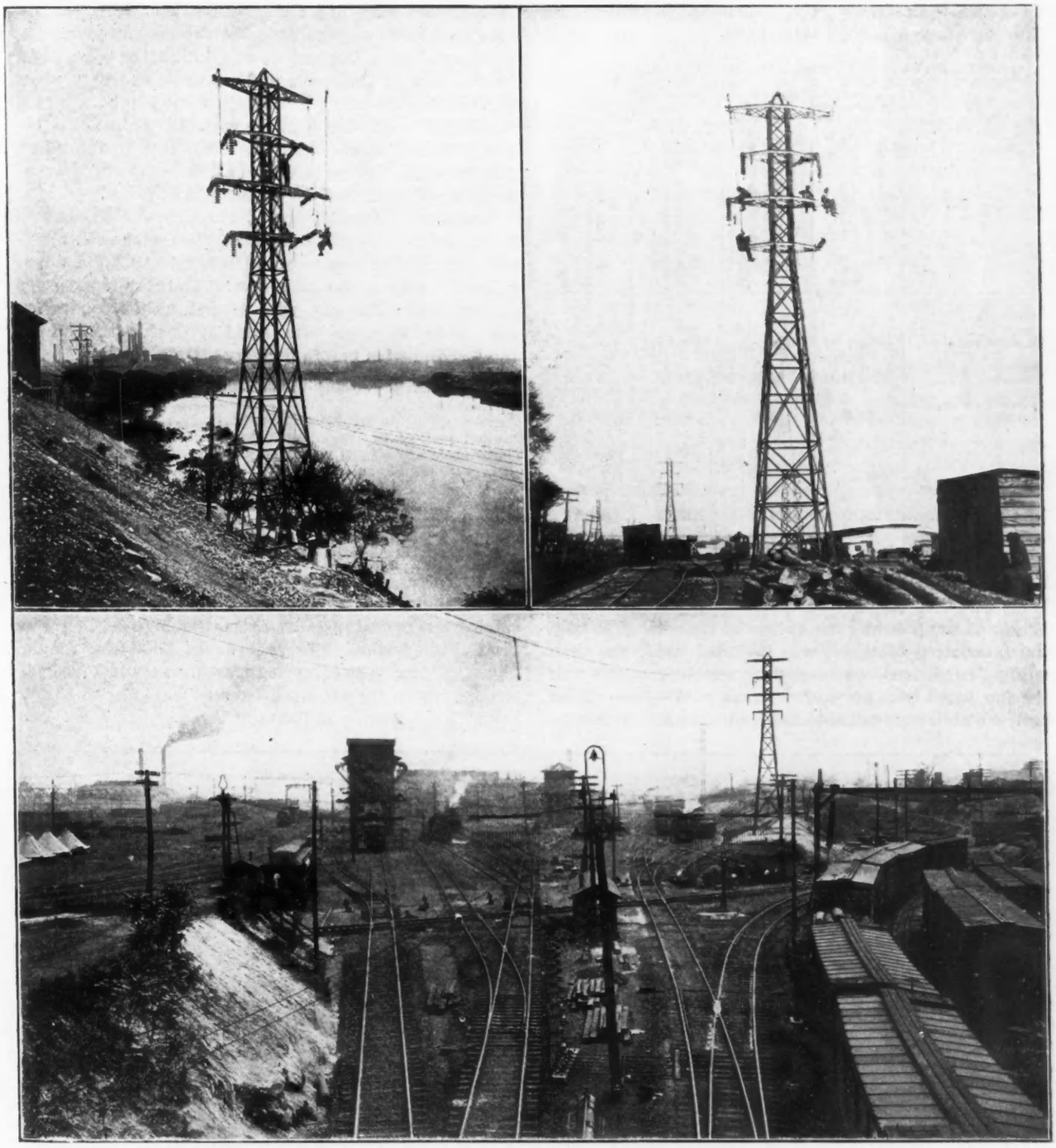
A very important link in the distribution chain and one which insures adequate and reliable electric service to the numerous industries between Philadelphia and Chester is the new high-tension circuit interconnecting the two systems. This line follows for the most part the route of the Chester branch of the Philadelphia & Reading Railway and a part of the Washington branch of the Pennsylvania Railroad. Many difficulties were encountered in construction. Along the Schuylkill low swamplands and then steep, sloping rocks were met with. Further south in the lowlands, near the city line,

much of the land is under water in the spring, and it was necessary to keep pumps in continuous operation to carry on excavation work. In the short stretch of line 564 piles averaging 25 ft. (7.6 m.) in length were driven, and approximately 4700 yd. (4297.7 m.) of concrete were poured for tower footings.

The electricity is carried by six 2/0 hard-drawn bare stranded copper wires, one circuit of three wires on each side of the supporting steel structures, which are erected at average intervals of 476.5 ft. (145 24 m.) Each circuit is protected by a 7/16-in. (11.1 mm.) copper-clad seven-strand steel ground wire, extending the entire length of the line and effectually grounded to earth at each structure. The vertical separation between wires is 7 ft. 6 in. (2.28 m.); the normal horizontal distance between the two ground wires and between the two center conductors being 16 ft. (4.9 m.) and between the wires of the other conductors 11 ft. (3.4 m.).

The steel supporting structures, 156 in number, are divided into three general types—river-crossing towers, angle towers and poles—the characteristics of which are shown in Table II.

The highest structure is at the river front of Station A. It weighs 32.06 tons (29.1 t.) and measures, from base to tip, 190 ft. (57.9 m.), the columns sloping in a



THESE ILLUSTRATIONS OF THE HIGH-TENSION LINE INDICATE CLEARLY SOME OF THE DIFFICULTIES ENCOUNTERED IN ITS CONSTRUCTION

graceful curve to the base, which is 28 ft. (8.5 m.) square. Wires are carried to a similar structure on the west bank of the river, a distance of 577 ft. (175.9 m.), the lowest wire clearing high water by 150 ft. (45.7 m.). Similar structures at Crum and Darby Rivers give clearance of 85 ft. (25.9 m.), while at the Chester River 100 ft. (30.4 m.) is allowed.

Angle towers taper to wide footings, and like the river-crossing towers rest on four separate foundations. The poles stand on one solid block of concrete, which averages about 6 ft. (1.8 m.) square, extending about 1 ft. (0.3 m.) from the ground, and varies in depth from 10 ft. to 12 ft. (3 to 3.7 m.), dependent on the height of the pole and the nature of the soil. One pole, the foundation of which was installed under the most adverse conditions, was tested by applying a pull near the top equal to a horizontal stress of 5000 lb. (2.268 kg.), which is equivalent to the load for which this type was designed. The steel deflected 7 in. (17.8 cm.) and the concrete foundation rose 0.075 in. (19.1 mm.), both returning to normal on release of the load.

TABLE II—DATA CN STEEL SUPPORTING STRUCTURES

	River Crossing Towers	Angle Towers	Poles, Strain	Poles, Suspension
Estimated Maximum Load	All wires down on one side plus 60-mile wind and ½-in. ice on structure and remaining wires	All wires and structure covered with ½-in. ice and supporting 60-mile wind to turn L of 20 deg.	All wires and structure covered with ½-in. ice and supporting 60-mile wind, L—5 deg.	All wires and structure covered with ½-in. ice and supporting 60-mile wind, L—1 deg.
Factor of safety	3	3	3	3
Size of main angles	8x8x¾ in.	6x6x⅝ in.	4x4x 7/16 in.	4x4x 7/16 in.
Maximum distance to low wire	162 ft.	83 ft.	73 ft.	88 ft.
Minimum distance to low wire	91 ft.	43 ft.	48 ft.	48 ft.
Diameter foundation bolts (inches)	2¼	1¾	1⅝ to 1⅜	1⅝ to 1⅜
Number of type used	8	35	35	78
Tonnage of each type	165.63	204.93	122.65	275.9

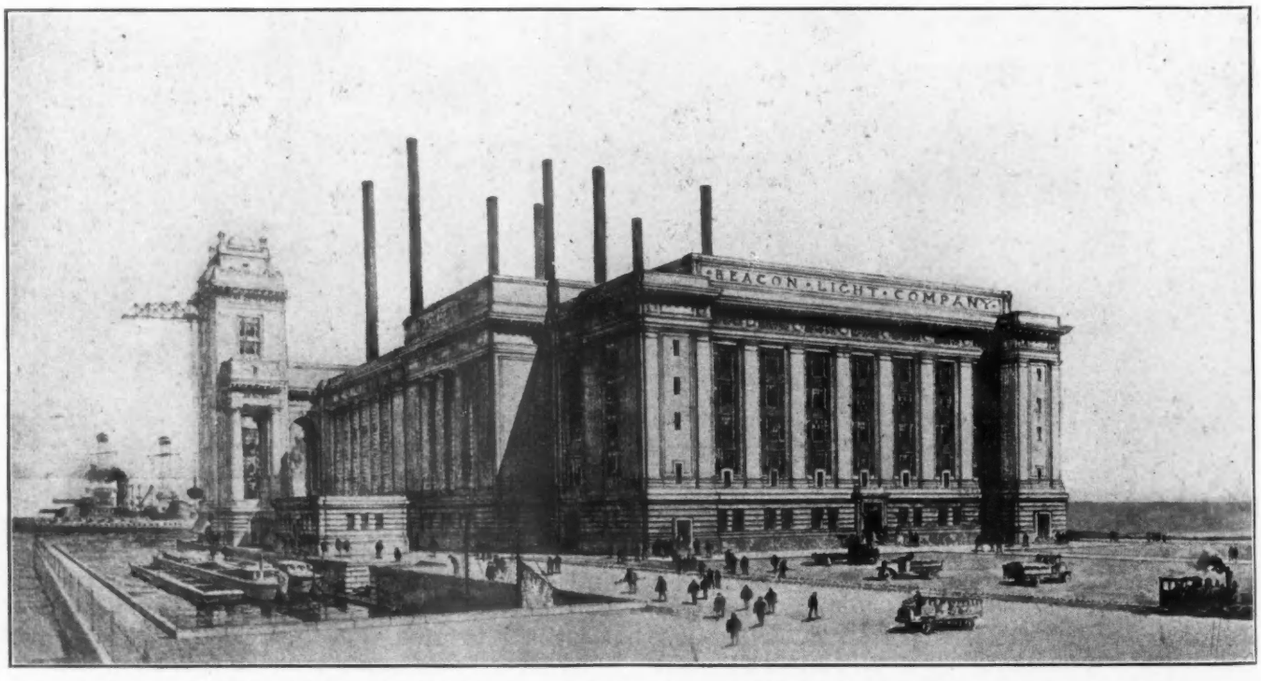
The insulation consists of porcelain disk insulators, 10 in. (25.4 cm.) in diameter, as manufactured by the Ohio Brass Company. When a strain is developed due to bends in the line or decided changes in elevation and where foreign wires or railroads are crossed nine disks or units are hung in a string in tension. With this arrangement two strings are used for each conductor at every cross-arm, the insulators lying in the same plane as the wire in the spans and a loop of the wire being made under the arm. For straight runs eight units are suspended in a string hanging vertically from the cross-arm. This distance from the cross-arm to the clamp for the strain string is 4 ft. (1.2 m.) and for the suspension string 3 ft. 8 15/16 in. (1.1 m.).

The line is suitably guyed throughout its length; ⅝-in. (15.9-mm.) S. M. stranded steel wire with a normal ultimate strength of 19,000 lb. (1335.7 kg. per sq. cm.) being used with a special Marchand clamp and attachments. The guy wire as well as the conductors and ground wire was also tested by the Electrical Testing Laboratories before delivery. Data for line:

Total length from substation to substation..14.08 miles (22.6 km.)
Average span .....475.5 ft. (144.93 m.)
Average clearance low wire to ground.....49.18 ft. (15 m.)
Normal average tension in conductor.....1,165 lb. ((528.4 kg.)
Normal average tension in ground wire.....1,780 lb. (807 kg.)
Strings of suspension insulators.....462
Strings of strain insulators.....936
Number of insulator units.....12,120
Total tonnage of steel erected .....769.11 (697.6 t.)

CHESTER SUBSTATION

At Chester, adjoining the site of the new waterside station under construction, is an outdoor substation receiving energy at present from the high-tension line from Philadelphia. There are six 5000-kva. single-phase, outdoor-type oil-cooled transformers installed for stepping down the potential from 66,000 volts to 13,200 volts. They operate in banks of three.



THIS NEW 120,000-KW. STATION AT CHESTER, PA., WILL BE INTERCONNECTED WITH THE PHILADELPHIA STATION

Serving Cantonment Tests Resourcefulness of Electric Company

How Some Problems Involved in Supplying an Encampment of 40,000 Men with Electricity Were Solved in Short Order by the Public Service Electric Company of New Jersey

BY E. B. MEYER

Assistant to Chief Engineer Public Service Electric Company of New Jersey

THE supplying of electric service for interior lighting, street lighting, motors and various other uses for the United States Army cantonment involves a number of problems which put to the test the ability of the utility company to meet in a short period of time the requirements of a city of 35,000 to 40,000 men. The site for the New Jersey camp is in the vicinity of Wrightstown, a small village in the midst of a farming

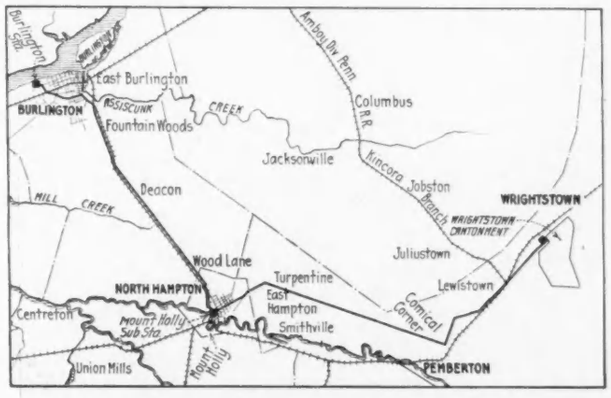


FIG. 1—ROUTE OF TRANSMISSION LINE ERECTED TO SERVE CAMP DIX

community about midway between Trenton and Camden. The decision of the War Department to construct a camp in this location has resulted in the very rapid transformation of Wrightstown from a small village to a town of about the population just mentioned.

The first step after the camp site was definitely determined was to provide a high-voltage line extension from the Public Service transmission system. Since the camp was beyond the reach of any of the existing lines, it was decided to run a No. 4 transmission line from the camp to the Mount Holly substation and to reinforce an existing line from Mount Holly back to the generating station at Burlington.

The line work was started on Aug. 13 and is now practically completed. Some difficulty was experienced on account of the fact that the pole line was located along an unimproved sand road which made hauling difficult. A gang of from thirty-five to forty men was engaged in pole setting, and on long sections where the right-of-way was free of obstructions as many as fifty poles were set per day. However, on part of the right-of-way where quicksand was encountered it was necessary to drive barrels into the holes during the digging process in order to reach the required depth. This additional work reduced the number of poles set, and where the soil was particularly bad the number set per day was only fifteen or twenty. The work of setting poles was greatly facilitated by the use of a pole-hoisting derrick as illustrated in Fig. 4.

The transmission line is of No. 4 copper wire, insulated for 26,400 volts but designed to operate at 13,200 volts. The insulators used on the line were tested by the company's laboratory under conditions of high voltage and high frequency before being set on the cross-arms. The poles are for the most part 40 ft. (12.19-m.) in height, but in some cases 50-ft. or 55-ft. (15.2-m. to 16.7-m.) poles were used in certain sections in order to clear trees or other obstructions.

In certain sections of Mount Holly both sides of the transmission line right-of-way are covered with heavy trees, some of which are more than 70 ft. (21.3 m.) in height. It was impossible to obtain tree-trimming privileges from the adjacent property owners, and as open-wire construction through the trees was undesirable, aerial transmission cable construction was decided upon. This is a special type of construction which has been used in a number of cases where the utility company has been confronted with new problems through rapid growth in commercial load, particularly where large power service is required for the operation of industrial plants. The tendency has been to supply such customers with high-voltage or primary service, necessitating in many cases the reconstruction of existing lines. By the use of the aerial cable run on poles and supported by messenger wire, a form of construction similar to that used in telephone work, it is possible to transmit high voltage where the installation of open wire would be out of the question and the cost of underground construction prohibitive.

In Fig. 3 is illustrated the method of making the connection by use of pot-heads between the open wires and the aerial cable. The cable consists of three copper conductors insulated for operating at 13,200 volts.

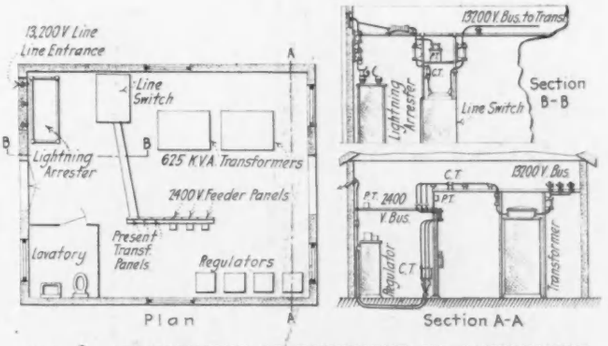


FIG. 2—ARRANGEMENT OF EQUIPMENT IN CANTONMENT SUBSTATION

It is of special construction for this class of service and consists of paper insulation on the individual conductors, a paper jacket and a reinforced rubber outer covering, the outer covering being similar in construction to that of the ordinary garden hose. The entire cable is cov-

ered with tape and saturated with rubber compound and a weatherproof braid thoroughly impregnated with waterproofing compound. For mechanical protection

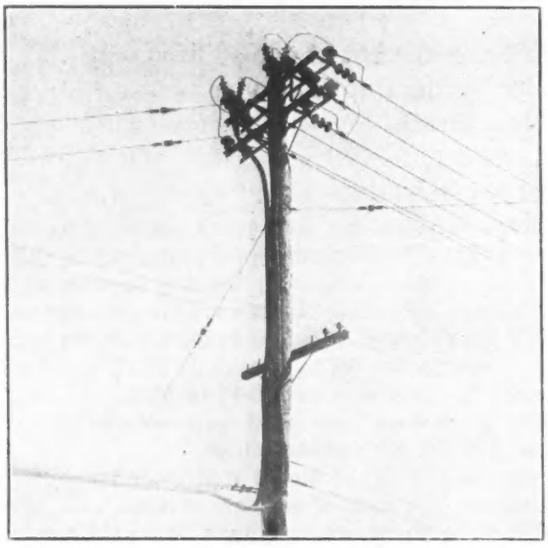


FIG. 3—METHOD OF CONNECTING OPEN WIRE WITH AERIAL CABLE

the finished cable is incased in an armor made up of galvanized-steel tape.

A substation of 1250 kva. rating will be provided to take care of the camp requirements. The equipment will consist of two 625-kva., 13,200/2400-volt, 3/3 phase transformers, four 48-kva. potential regulators connected in V (the secondary distribution system being three-phase), and necessary switching and metering equipment. The estimated peak loads on the substation are as follows: Interior lighting, 500 kw.; street lighting, 70 kw.; miscellaneous small motors driving laundry machines, refrigerating machines, etc., 150 kw., making a total demand of 720 kw.

One of the problems was that of securing prompt de-

FIG. 4—PORTABLE DERRICK USED IN ERECTING POLES

livery on the electrical equipment for the substation. It was realized that it would be impossible under present conditions to obtain the necessary transformers unless pressure could be brought to bear on the manufacturer. The company therefore decided to take the matter up with the government officials at Washington, and three transformers were located at the shops of one of the large manufacturing companies. These transformers were diverted by the government from the original purchaser to the camp, to insure service on the date set. A general arrangement of the electrical equipment is shown in Fig. 2.

The workmen engaged in construction work start at sunrise and work until dark. Some idea of the rapidity with which construction work is carried on may be gained from the fact that when one of the company's engineers discussed with contractors and army officers

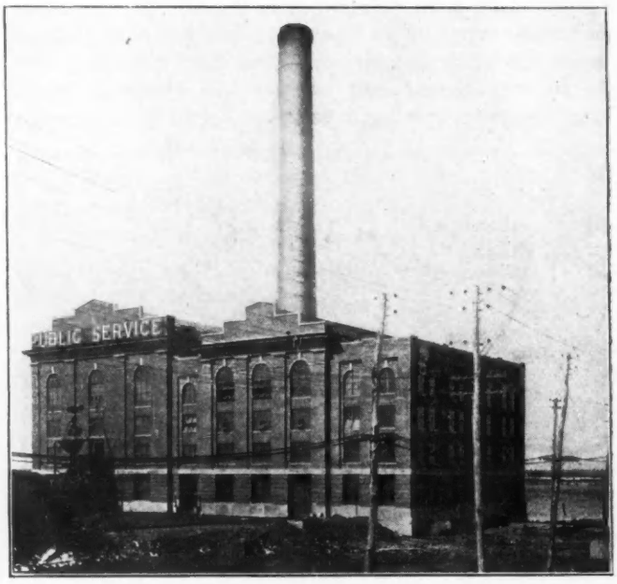


FIG. 5—BURLINGTON STATION, FROM WHICH CAMP IS SERVED

the question of erecting the substation building he was informed that the building would be started at once and completed in about a day and a half.

Lamp with Renewable Filament

An incandescent lamp which can be readily recharged with gas and fitted with a new filament is disclosed in patent No. 1,232,741, issued to A. J. West of Winnipeg, Manitoba. In this lamp, which is of the gas-filled type, there is no need for a vacuum as it is only necessary to retain the gas in the globe under its own pressure. Accordingly, the lamp is so made that the globe can be removed to permit the renewal of the filament, and when the globe is attached to the head the joint is tight enough to retain the gas admitted. Further, in the head is provided an easy means for refilling the lamp with gas and retaining the gas.

Upon the filament being rendered useless the globe can readily be unscrewed from the head and the filament withdrawn through the neck of the globe. After a new filament has been substituted the globe can be replaced. At this time, however, it is necessary to recharge the globe with gas. This is done by removing a screw plug and recharging the globe with gas through a provided opening. Upon the globe being filled with the gas it is screwed tightly in and the plug is inserted.

The Power Problem of the Munition Plant

Two Years' Experience in One of the Largest Rifle and Cartridge Factories of the World Indicates the Necessity of Adequate Equipment and of Its Reliable and Efficient Operation

BY SYDNEY FISHER

ALTHOUGH power is an important factor in production, it receives very little consideration compared with other factors. Power must be available in sufficient quantity when required, and its supply must be unfailing. Production must never be held up for power; on the contrary, power must be ever ready for production. These exacting requirements can be met and are met in modern plants with electric service, and yet the cost of this vitally important factor in production does not amount, in many cases, to more than a few mills per unit of product. This has been made possible by the remarkable development of electrical equipment.

Not only in the supply of motive power and power for lighting has electricity simplified production, but also in its application to production processes. Temperature control, so important in delicate heat-treatment operations, is a reality, and losses due to radiation, etc., are very small. The electric welding machine is used not only for welding, where it has eliminated many operations, but also in delicate heat-treatment operations where high local heating is required. It is also used in heating and clinching rivets, these operations being performed at once. Electric plating and cleaning baths have greatly simplified operations which heretofore were difficult and expensive. The battery truck has made rapid transportation over short distances possible with economy in time and help. Scientific heat treatment has been made possible by the development of the thermo-electric couple for pyrometry. The telephone, the telecall, the fire alarm, all play a very important part in plant operation.

Efficient Operation and Reliable Service Chief Considerations

Reliable equipment is only one part of the problem, however—a very important part, to be sure, but not the all-important part. Enough power and continuity of service is the prime consideration of the power engineer, but over-equipment in any part of the system will result in poor operation and unreliability when the plant is in full swing. Efficiency and continuity of service can only be obtained through scientific selection and arrangement, careful installation and operation, and proper maintenance of scientifically designed reliable equipment.

It is hoped that the following suggestions, based on two years' experience in power work at one of the largest munition plants in this country, if not the largest, will be helpful to those engaged in present and future power work. Suggestions will be offered under the following headings: (1) organization, (2) selection of equipment, (3) inspection, (4) installation, (5) operation, and (6) maintenance.

The power engineer and the production engineer of a munition plant, or, in fact, any manufacturing plant, should each be responsible to the chief engineer. On no account should the power engineer be responsible to the production engineer. The production engineer is always afraid of an insufficiency of power. If allowed to have his way, complications will ensue.

Selection of Equipment

Generating equipment rated at 2300 volts, three-phase, 60-cycle, with 440-volt power and 110-volt lighting equipment, is without question the best system for industrial plants, in the writer's opinion. This is true from the initial-cost, operating and maintenance standpoints. The selection of generating, controlling, transmission, transforming and distributing equipment should be based on the assumption that a high motor load factor (90 per cent) will be maintained where possible and that the necessary synchronous apparatus will be installed at the load to bring the power factor up to 80 per cent at the transformer stations. This will result in the correct design of all branches of the system, insure subsequent efficient operation, reduce the possibility of breakdown to a minimum and reduce the cost of equipment.

Careful selection of motor equipment can be made without a large expenditure of time and money. Elaborate test equipment is not necessary. A young electrician carefully instructed and provided with several ammeters (0-15 amp., 0-75 amp. and 0-150 amp.) and with a suitable voltmeter can do all that is necessary. Records should be made of the minimum, average and maximum currents and the order and frequency of their occurrence. All peculiarities of the work cycle can be expressed in terms of current. The corresponding power output values can be obtained from a current-horsepower output curve plotted from manufacturer's data on efficiency and power factor at various loads.

The rated output of the motor should equal the average load demand. Peak loads not exceeding 150 per cent rated load and occurring at intervals for short periods may be taken as an overload. This apportionment of motor to load will insure a power factor of 80 per cent. The first two or three motors will have to be selected by well-based guesses. After tests have been made on these units the results can be used in making more scientific selections of the other units. At the plant on which the writer bases most of his opinions 400 motors aggregating 6000 brake-hp. were selected in this way. Careful study of the work cycle often results in the coupling of two drives on one motor with resulting adequate power for each and a high motor load factor.

When the load is intermittent and fluctuates, as in the case of drop hammer and heavy press drives, a high average load and consequent high power factor is unobtainable. In such cases a synchronous motor exhauster fan or blower drive should be used, it being advisable to select a motor which will have sufficient

reactive power capacity to raise the power factor of the load to 80 per cent. Where possible reactive power should be supplied at the load, thus increasing the generator, transmission-line and transformer capacity for useful average power and reducing equipment and transmission losses. The 2000-kw. turbo-generator unit is a good unit for industrial plants. Where the space is not too limited two such units are advisable, one of the bleeder type and the other of the mixed-pressure type, as they make the best use of low-pressure steam during winter and summer months respectively.

Control apparatus is pretty well standardized. In addition to standard exciter, generator and feeder panels, a station recording voltmeter, a power-factor meter, a voltage regulator and a ground detector (three-phase) will be found necessary. Power-limiting reactances are not a necessity even with time-limit relays, as the reactance of modern generators is sufficient to limit the current of the usual short circuit.

Combined turbine, motor-driven exciters are to be recommended for munition plants. Under normal conditions of operation the exciter is motor-driven. Should the speed of the motor drop below 95 per cent synchronous speed, the turbine automatically takes the load. This insures sufficient power for the station lighting in the event of a shut-down.

Fiber duct gives very good results for underground transmission. Manholes should not have perforated covers, should be shaped to the lay of the cable and should be made thoroughly waterproof. Should a circuit pass near furnaces or heated area, it should be run through a tunnel opening into a well-ventilated manhole at each end. Overhead transmission is less expensive and quickly installed but is easily tampered with.

Value of Several Motors to Each Machinery Group

Motor equipment should be selected on the basis of two or more to each group of machinery. This arrangement is more expensive, but is preferable for several reasons. For instance, a high motor-load factor is more easily obtained, a 42-hp. average load being better supplied by three 15-hp. motors, or one 20-hp. and one 25-hp. unit, than by one 50-hp. motor. Obviously when power requirements are uncertain and quick deliveries of small sizes are possible, a number of smaller sizes is better than a few large sizes. Furthermore, if the motor equipment is reduced to a few standard sizes (5 hp., 10 hp., 15 hp., 20 hp. and 25 hp.) fewer "spares" are required and the expense is less, the units being smaller.

With this arrangement, if many machines are idle or the duty is light, whole sections can be run on one of the motors, the others being disconnected. Another advantage of this arrangement, especially in a plant just being built or extended, is that operation does not have to be delayed by deliveries of equipment. If the generator capacity is small owing to slow delivery of units, loading up one motor in the section instead of having two or three running lightly loaded will relieve the station units of unnecessary reaction power load and hence increase the station capacity for the average power load. In the writer's experience a 20-hp. motor has taken the load of an entire group (33 hp.) for two hours, with the aid of an ordinary desk fan to keep it cool, while the other motor in the section was being replaced. This is another reason why there should be more than one motor driving the group.

Money spent on circuit breakers to isolate circuits is by no means wasted. A short circuit at some remote point will shut down an entire feeder, perhaps the plant, unless some precautionary measure is taken. Overload relays are not desirable on individual motor circuits, however, unless steps are taken to study the work cycle and set them for the maximum current. Furthermore, they also must be inspected frequently, otherwise they will trip and shut down a group of machines, causing unnecessary delay. If a motor is carefully selected and fused for the maximum current, there should be no trouble. A 440-volt circuit is advisable for motor applications, as the copper for a 220-volt circuit is expensive.

In the opinion of the writer the incandescent lamp is best for lighting, 60-watt and 100-watt units providing general illumination being preferable for production work and 25-watt or 60-watt individual lamps for tool and assembly work. Vapor lamps, while they possess advantages as regards quality of light, are easily damaged and the maintenance is high.

Inspection and Installation of Equipment

Standard apparatus, such as motors, transformers, control equipment, etc., as supplied by reliable firms, are carefully inspected at the shop. Frequently, however, machines built to supply a less urgent order are supplied, and while they may be identical in design, they have different characteristics. In the writer's experience, three exciters specified for parallel operation were subsequently found to be over-compounded, flat-compounded and under-compounded respectively. The adjustment could have been made very easily at the shop but involved considerable time and expense after installation.

Tests for grounds in the fields of generators should be conducted. If the system is installed on contract, the layouts should be studied carefully and the sizes of bus copper and cable from generator through to motor should be checked. It is surprising how errors creep into a mass of detail. Connections for 300-kva. transformers may be installed for 500-kva. transformers. Such errors do not come to light until the plant is in "full swing"; then the tar begins to drop and the bus copper changes color. Contacts of circuit breakers should be inspected with a thickness gage to detect poor contacts before they cause trouble.

While cable purchased from a reliable firm is guaranteed for a year, the reels should be meggered before and after being drawn through ducts. A megger test set is expensive, but it will be found invaluable in locating defects and ascertaining the condition of equipment. Transformer taps should be carefully checked, as phase reversal may cause considerable trouble when two transformer houses are tied together. While awaiting installation do not allow transformers to remain in the rain uncovered. The air gap and oil rings of motors should be inspected and the rotor should be tested to see if it binds. Compensator contacts should be inspected, as three-phase starting and single-phase running, due to a bad contact on the running side, is by no means uncommon.

The installation of generating, transmission and transforming equipment is usually and preferably placed in the hands of contractors. Curves showing

daily progress in all branches of work should be plotted on one sheet and the contractor consulted to ascertain the cause of delay in any branch of the work. Installation should be constantly checked from drawings as defects do not come to light until the plant is in full operation, by which time the bills may be paid.

The power engineer should consult with the machinery lay-out department to determine the best grouping of machines from a power standpoint, and to eliminate short double-cross belts where possible and the arrangements which require excessive starting currents and needless constant expenditure of energy in overcoming friction. He should recommend chain drives, as they will transmit overloads. Motors are frequently regarded as underrated because the main drive of a belt, particularly on a damp day, is very inefficient. Excessive belt tension is frequently the cause of a seized motor bearing. A motor should be given a central position relative to the group of machines it drives, and the motor pulley should be placed under a girder.

Operation of Equipment

Instruction cards should cover the operation and maintenance of every piece of equipment in the plant. No doubt should be left in the mind of the operator. Rules for starting, stopping and oiling should be very complete. Rules giving the method of procedure in case of shut-down can be drawn up to cover nearly every possible condition. A complete set of instruction cards will prevent shut-down, shorten the period of shut-down and place responsibility on the right person. A comprehensive set of signals (whistles and colored lights) should be in operation in the station, covering the starting and stopping of the main units and auxiliary apparatus.

Voltage regulators are a boon, but they fail sometimes. They may operate satisfactorily twenty-four hours a day for six months and then fail, causing the station to lose the load. Once in six months is once too often when a 10,000-hp. load is dropped and about 25,000 men are forced to be idle. At the plant where the writer is engaged periodic shut-downs were experienced until the regulator was made semi-automatic. If the regulator fails as now adjusted, the station voltage drops only to a certain value, which insures against dropping the load. This is done at a sacrifice of the automatic feature whereby the voltage is maintained constant under all conditions of load; hence the operator must adjust the generator and exciter fields when the load "goes off" and "comes on" at recess periods to keep the regulator on the line.

The field excitation of each generator should be adjusted so as to maintain the same power factor in each unit, as under this condition the station capacity will be a maximum. In some cases machines operate better at a lower or higher power factor. Sometimes it is desirable to raise the average power load of a bleeder turbine in order to obtain as much low-pressure steam as possible. Another precaution to take is to keep tie switches open when it is not necessary to have them closed, as the fuse capacity is doubled and the damage due to short circuits is thereby increased when they are closed.

Operators should be instructed to start motors with quick decisive motion. "Hobbing" should be discouraged, especially when belts are being put on. If the proper compensator taps are used, the acceleration will be such as to permit applying any belt without danger to the operator.

Where there are several motors on a floor one man should be detailed to start all of them so excessive starting current will be avoided. In addition, the man on the first floor should be instructed to begin starting motors at ten minutes before the starting time, the man on the second floor at eight minutes before, etc. Where the plant is all on one floor the same effect can be produced by starting the departments in succession with small intervals between. The station switchboard operator should be notified when synchronous motors are either started or stopped, as reactive power load suddenly thrown on the station may cause trouble.

Maintenance of Equipment

Maintenance men should be assigned to inspection when not employed in actual breakdown service. The importance of adequate inspection cannot be over-emphasized. Systematic inspection brings defects to light before they reach the danger point.

Ground detectors should be installed in the generator field circuits and a three-phase ground detector in the main circuit. The station equipment should undergo a thorough inspection at short intervals which should include the inspection of oil-switch contacts and the timing of relays.

Duct lines should be inspected frequently, at which time manhole conditions should be observed and cables tested with a megger. Every feeder should be tagged in every manhole with a waterproof label. In addition there should be a diagram of each manhole showing the position of each feeder. A cable test set is not expensive and will be found very useful not only for locating grounds or other defects in cable but also for determining resistances all over the plant—magnetic chuck repair, pyrometric work, telephone work, etc.

Transformer houses should be roomy, well lighted, well ventilated and clean. The cause of water condensation anywhere should be investigated immediately. Transformer oil should be tested for water content at frequent intervals.

Motor inspection should be very thorough. Slip rings should be inspected for pitting and oil rings should be tested to see that they turn. More motors shut down because of seized bearings owing to the lack of oil and also to stationary oil rings than from any other cause. The adjustment of overload relays and circuit breakers at frequent intervals should also be checked periodically. Compensator contacts should be inspected and replaced when badly burned. When a motor has the appearance of being heavily overloaded, a search should be made for bad contacts on the running side of the compensator. The maintenance of compensators is usually very high but can be reduced by careful instruction regarding the proper method of starting and by systematic inspection.

The power engineer and his assistants, even though well organized and well fortified with departmental rules and comprehensive instruction cards, would do well to leave the office and stroll through the plant quite frequently. The power engineer should trust his assistants to the point of supporting them in a controversy. He should hand a problem to an assistant and then forget about it until the latter makes his report.

Street Lighting for Small Cities and Towns

The First of a Series of Articles, in Which General Principles Are Discussed, Including Brightness, Silhouette Effect, Shadows, Glint, Glare, Spacing and Shade-Tree Interference

BY JAMES R. CRAVATH

The series of articles on the street lighting of cities of 50,000 and less of which this is the first installment will probably contain little on the subject that has not appeared already in the transactions of our engineering societies under the authorship of leaders in this line. The function of these articles will be to bring together in convenient shape for the central station man who is taking up the subject with his municipality some of the best current thought and information on the subject. The field is one in which rapid progress has been made, and it is not always easy for the man engaged in miscellaneous light and power work to keep track of the advances in this special line, which he is only called upon to consider at rare intervals. The present installment will take up general principles, discussing production of roadway and sidewalk brightness, seeing by silhouette effect, seeing by illumination on objects, shadows of road obstructions and irregularities, glint, glare and interference with seeing, relation of spacing to street illumination and glare, shading to avoid glare, and the avoidance of interference caused by shade trees.

BEFORE street lighting can be intelligently planned it is necessary to have a clear idea of just what is to be accomplished by the lighting. While the general objects can be stated in a few words, an analysis of these soon leads one into a rather complicated situation which can be only briefly reviewed in this article.

Stated in very general and popular terms, the objects of lighting streets can be summed up as follows:

1. In all classes of streets the least that can be expected of street lighting is to enable a person to see his way about at night.

2. On some classes of streets the production of an especially well-lighted effect, either on account of congested traffic or because of the ornamental and advertising features, is desired in addition to the first objects named.

On a large majority of streets lighting for purposes of seeing, without much regard to producing enough light for advertising or ornamental effect, is all that can be expected. Even on such streets, however, there will naturally be some difference in the severity of the requirements. The more traffic on a street the greater is the amount of outlay justified for street lighting and the greater is the necessity for safeguarding users of the street from collisions and attack.

As to the things it is especially necessary to see on a street at night in order to see one's way about, one might elaborate at length and in great detail, but to mention a few of the principal ones will suffice. For both pedestrians and drivers irregularities and obstructions of the street surface must be seen. Likewise, other persons using the street must be seen in order to avoid collision. The value of street lighting

in preventing crime is probably about in proportion to the quantity of such lighting. On some of our worst-lighted streets it is of little value, while on the most brightly lighted downtown streets conditions as to crime prevention are virtually equivalent to daylight.

Technically the object of street lighting is to produce a certain amount of brightness on street surfaces and upon users of the street. In the daytime there is such a superabundance of light that the distribution of brightness on street surfaces and various objects need not be analyzed very closely; but where the amount of artificial light must be as meager as it is in a majority of streets in small cities a much closer analysis is needed.

Distinction Between Incident Illumination and Surface Brightness

The distinction between the illumination incident upon a surface (such as a pavement, sidewalk, tree, vehicle or person) and the surface brightness of such objects must always be kept in mind. It is brightness that we see, that produces the effect on the eye. The illumination on a surface produces the brightness we see, but it does this only by virtue of the light reflected from the surface. That is, the brightness is always

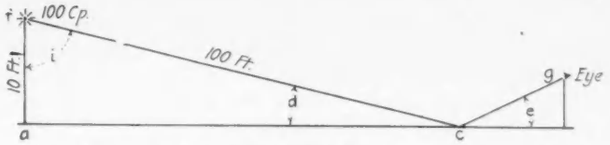


FIG. 1—DIAGRAM FOR BRIGHTNESS AT DIFFERENT POINTS

proportional to the incident illumination minus the loss by reflection. Since the reflecting power of various surfaces differs greatly, their brightness under a given illumination differs in like proportion.

Between a very new macadam or concrete surface and black mud there may easily be a difference of ten to one in diffuse reflecting power. To produce equal brightness, therefore, the illumination would have to be ten times greater on the black mud than on the light macadam, and the unfortunate thing about this is that there is usually less money available to illuminate the mud than to illuminate the macadam. By daylight a considerable portion of our seeing is by virtue of the different color and reflecting power of various surfaces, although differences in illumination, commonly known as light and shade effect, also have their influence. At night, with street lighting, differences in illumination from different directions causing light and shade have a much greater effect.

Silhouette Effect

How important they are was probably not realized until 1910, when Preston S. Millar pointed out that a considerable portion of our seeing on the streets at night is by virtue of the silhouette effect. That is, we see many upright objects, such as persons and automobiles, at a distance not so much by the light reflected from them as by the light background against which they appear as silhouettes. This is especially true in large cities where the background consists almost entirely of pavement, sidewalks and buildings, which are better reflectors and consequently appear brighter than vehicles and persons in dark clothing. Fig. 2, taken from Mr. Millar's original paper before the Illuminating Engineering Society dealing with silhouette effect, shows the latter very clearly.

On dirt streets or where oiling has rendered the pavement a very dark color the effect is not so pronounced. However, even oiled streets, if so well traveled by automobiles as to take on a kind of glint or polish, reflect considerable light by what is known as specular reflection in distinction to diffuse reflection. Specular reflection is the same as that which takes place from a mirror. It makes these oil-polished street surfaces appear quite bright at certain angles.

If the background is not brighter than the object, the only way the object can be seen is by having sufficient illumination upon it to make it enough brighter than its background to be recognized. An example of this is the street name post seen in Fig. 2. Sometimes the same object is seen partly by silhouette and partly by illumination upon it, as in the case where part of the object is seen against a bright background and part against a dark background. The bearing of these silhouette and illumination effects on the spacing and equipment of street lamps is taken up later.

Road obstructions, such as stones and bricks, for example, may be seen either by illumination or silhouette, but are usually recognized fully as much by the shadows they cast as by any reflection from their own surfaces. Holes and depressions in sidewalks and pavements are usually also recognized by shadows, except when close under a street lamp.

Effect of Shadows

The National Electric Light Association committee on street lighting for 1914 made some elaborate experiments on a street in New York City to determine the merits of various lamp spacings and mounting heights and various types of light distribution from the lamp. Considerable attention was given to tests in which a number of observers were required to locate obstructions or targets placed in the street as they walked or drove along. The principal result of this investigation showed that obstructions such as stones in the street could be better seen with lamps so spaced as to give some shadows behind these obstructions than with the lamps placed at such frequent intervals and so equipped as to produce a more uniform illumination with less pronounced shadows. In all of these experiments, however, the lamp spacing was relatively short as compared with common practice in smaller cities. As uniformity of illumination comes high in first cost on account of the large number of lamps and lamp supports required per mile of street, there is no great danger that streets will be lighted too uniformly for best results in the smaller cities.

Seeing by glint effect is a term used among engineers to apply to effects obtained when surfaces are wet or where they are highly polished so that there is specular reflection from small portions of them. On rainy nights glint from the wet sidewalks and pavements takes the place of the partially diffuse reflection ordinarily received. Many images are then seen of the street lamp reflected from the wet pavement and pools of water. Glint is also especially useful in locating mudpuddles with the aid of rather distant street lamps.

In connection with seeing by silhouette, the value of this effect is in many cases greatly increased by the

fact that there is just enough glint or specular reflection from the paving or sidewalk for the illumination at points midway between street lamps to produce much greater brightness in the direction of the eye than if the whole of the street were a purely diffuse reflecting surface.

Referring to the diagram of Fig. 1, *F* is a street lamp 10 ft. (3 m.) above the ground and *G* is the eye of an observer. What is the brightness of the street surface at points *A* and *C* to the observer? We will assume first that the street surface is a new, white, dusty macadam which will approach a diffuse reflector in its characteristics. Now a diffuse reflector will appear equally bright from all directions, no matter from what direction illuminated. Consequently the brightness at various points along the street will always be directly proportional to the illumination. Thus, at point *A* if the lamp is of 100 cp., the illumination will be 100 cp. divided by 100 (which is the square of the

FIG. 2—THE CAB IS SEEN BY SILHOUETTE EFFECT WHILE THE STREET-POST SIGN IS SEEN BY DIRECT ILLUMINATION

distance), or 1 ft.-candle (10.08 lumens per sq. m.). At point *C*, assuming that the lamp emits 100 cp. in that direction also, and that the distance *F* to *C* is 100 ft. (30.48 m.), the illumination on the street surface at *C* will be by the same process of figuring 0.01 ft.-candle (0.108 lumen per sq. m.) multiplied by the cosine of the angle *I*, or in other words by the ratio of 10 ft. (3 m.) height to 100 ft. (30.48 m.) distance, thus making the actual horizontal illumination at *C* 0.01 ft.-candle multiplied by 0.1 or 0.001 ft.-candle (0.0108 lumen per sq. m.). The illuminations and brightnesses would therefore be in the ratio of 1 at the point *A* to 0.001 at the point *C*. Evidently with an object between the eye and point *C* as a background there could be very little silhouette effect, while between the eye and point *A* there would be considerable.

If, however, the street surface is glossed with oil or moisture, the character of reflection from it is entirely changed. Instead of appearing equally bright in all directions about any given illuminated spot, it will appear very much brighter when viewed from an angle equal to the angle of incident light. Consider the light which falls on point *C* from the lamp at *F* and is reflected to the eye at *G*. If angles *D* and *E* are equal, and if point *C* were a mirror, the brightness entering the eye from point *C* would be practically the brightness of the source of light at *F*. If the point *C* is a piece of glossy oiled street surface, it will not behave exactly like a mirror, nor will it act as a diffuse reflector, but its action will be intermediate between the two. It will appear very much brighter when viewed from a direction approximating *CG* than from other angles. The point *A*, on the other hand, will appear considerably less bright than if it were a diffuse reflector. This tends to counteract the enormous difference in illumination falling upon these two points. The practical effect of this as brought out by Millar in various tests is that even on an asphalt street which does not have the polish common to heavy automobile traffic the brightness varied only at the ratio of 2.7 to 1 with lamps 260 ft. (79.25 m.) apart, while the horizontal illumination varied forty to one. Here again it may be noted that the polishing of a street pavement due to heavy traffic of any kind is more conducive to uniformity of brightness in spite of the non-uniformity of illumination than are the conditions prevailing in the smaller cities. However, these points must be recognized in all classes of street-lighting problems. It should be remembered in considering the illumination and values cited in Fig. 1 that no allowance is made for any illumination that may be obtained on point *C* from another lamp placed at the back of the observer.

Relative Values of Horizontal and Vertical Illumination

There has always been considerable discussion in street-lighting circles as to the relative value of vertical as against horizontal illumination for street-lighting purposes. It is now generally recognized that both the horizontal illumination on the street surface and the vertical illumination on vertical objects such as pedestrians and vehicles must be taken into account. The relative weight given to these two in making up a good street-lighting system will depend very much on the character of the street surface. The importance of the silhouette effect has already been enlarged upon. It is evident that in producing silhouette effect illumination of the street surface is the important thing. However, if the street surface is so dark that it is difficult to get a well-illuminated background, one must fall back upon vertical illumination of objects. It is largely a waste of time to discuss the relative importance of vertical and horizontal illumination, because with any practicable mounting heights of lamps the illumination midway between lamps by vertical illumination will be approximately a constant ratio to the horizontal illumination, and no amount of practicable shifting of lamp height and spacing is likely to change this constant enough to have much practical bearing on the subject under discussion at this time.

Lamp Spacing

We have seen that variations in intensity of illumination falling on the street surface from points immediately under lamps to points midway between are necessarily very large even with the most skillful use of appliances for directing the light of the lamp in directions where it is most needed. The figures given in connection with Fig. 1, already explained, where there

is shown a variation of a thousand to one within 100 ft. (30.48 m.) for the horizontal illumination, illustrate this forcibly. However, with more frequent spacing and by figuring in the effect of neighboring lamps these differences are rapidly reduced. For brightly lighted city streets a variation of ten to one between lamps at points on the street surface is not likely to be noted. Where lamps are as frequently spaced as on business streets the question of improving the uniformity of illumination does not offer itself. This applies to the present-day common spacing of ornamental systems, which are from 60 ft. to 150 ft. (18.29 m. to 45.72 m.). With special care this distance can be exceeded and still produce satisfactory uniformity, although the ornamental effect may not be what is desired. In outlying streets where first cost tempts the designer to space lamps at long intervals the poorly illuminated spaces midway between lamps come in for first consideration. On such streets chief interest centers on the points of minimum illumination between lamps. Anything and everything which will bring up this minimum between lamps is desirable if it can be obtained for a reasonable outlay. With a given lamp equipment the illumination midway between lamps will fall off approximately inversely to the square of the distance. That is, doubling the distance between lamps reduces the minimum illumination to one-fourth. Add to this the fact that the longer the interval between lamps the less the amount of brightly lighted background against which things can be seen by silhouette effect and difficulties are further increased. Lamp spacings of 600 ft. to 1000 ft. (182.88 m. to 304.8 m.), which in years past have been so common among smaller cities, are entirely inadequate and inefficient. Furthermore, under modern conditions they are unnecessary from the economy standpoint.

AVOIDANCE OF GLARE

The avoidance of glare has long been recognized among experts as desirable in street-lighting practice, because it has been known that the existence of glare from lamps near the line of vision causes a decrease in the seeing ability of the eye—or, in other words, in the visibility of objects—so that to all practical intents and purposes more light is required on objects in order to see them clearly than if the source of glare were removed. Quantitative investigation of this subject has been made at considerable length by A. J. Sweet, some of whose results have been checked by Preston S. Millar. All of these results show that there is considerable disturbance of vision when a bright lamp is brought within 15 angular degrees of the center line of vision. As the effect of glare increases rapidly as the lamp is brought nearer to the center line of vision, especially within 6 deg. to 8 deg., there is considerable to be gained in efficiency of illumination as measured from the ocular standpoint by hanging the lamp as high, and consequently as far out of the ordinary line of vision, as possible. While no very exact figures can be given, it may be said in a general way that unnecessarily low hanging of lamps may often be the equivalent of throwing away half of the light generated because of the depressing effect on vision of objects which must be seen past a bright street lamp. The use or non-use of a diffusing globe in a lamp apparently has very little effect on the glare, the glare effect being dependent upon the candle-power; or, to be more exact, it depends according to the best information obtainable, upon the square root of the candle-power of the lamp used as emitted in the direction of the eye. The only feasible remedy for street-lighting glare yet evolved is the increase in mounting height of the lamps, and this is well worth while, especially in the range from 10 ft. to 15 ft. (3 m. to 4.5 m.). According to Sweet's investigation, if the glare effect be taken as 1 at a height of 32 ft. (9.7 m.), it becomes about 1.9 at the height of 22 ft. (6.7 m.), about 3 at a height of 16 ft. (4.8 m.), 4.3 at 15 ft. (4.5 m.), and 8.4 at 12 ft. (3.6 m).

DIRECTING DEVICES AND SHADE-TREE INTERFERENCE

Of course, with lamps at greater heights, to avoid glare the necessity of directing devices to bring down to earth the light flux which would otherwise be wasted in the upper region becomes greater and the cost of posts is increased. On the other hand, greater height permits longer spacing between lamps without too much loss of uniformity. The question of increased cost of high poles will be taken up in a later installment. The use of directing devices to save light will also be taken up under its proper heading. The shading of street lamps to avoid glare, which at first thought would seem one of the simplest solutions of the glare portion of the problem, has never been practiced to much extent, and its uses are confined principally to drawbridges, where exposed street lamps would interfere with navigation signals. The effective shading of lamps to prevent glare would mean the cutting off of all light above an angle of 20 deg. to 25 deg. below the horizontal. If a shading reflector or other device is to be used which cuts off light above 25 deg. from the horizontal, the lamp would have to be mounted 42 ft. (12.8 m.) above the ground in order to light the ground 100 ft. (30.4 m.) away from a point under the lamp. This sufficiently illustrates the difficulties.

Interference with street lighting by shade trees is a very live subject in the majority of cities, and especially in the smaller cities and towns under consideration. While the majority of such towns have many shade trees, there is considerable difference in the proper method of treatment. In some streets the trees are very large and permit of trimming high to prevent interference with lighting. In other places the trees are of an age where trimming high enough to prevent interference with the lighting is out of the question. Where the trees are too small to admit of high trimming center-lamp suspension will usually be necessary to prevent undue shadows. In such a street no locations can be found except in the center which will not involve considerable obstruction of the light by shade trees. On the other hand, where the trees are very large so that they can be trimmed high to form a high arch over the street the principal trouble with shadows is not from the boughs and leaves but from the large trunks, which standing in line along the parkway form an effective light barrier for the sidewalk. On such streets the location of lamps in line with one of the row of tree trunks permits the complete lighting of the roadway and of the sidewalk on the side on which the lamp is located, and causes light to shine through the row of trunks on the opposite side of the street at an angle sufficiently oblique to permit the location of the sidewalk always to be seen, and the area of the sidewalk in the shadow is reduced to a minimum.

MODERN STREET LIGHTING AN ASSET TO SPOKANE

Aspect of Streets, Appearance of Crowds and Morality, Peace and Order Improved by New Lighting System in Business Section

BY REN H. RICE

How a modern system of illumination makes a good street a better street and makes a good city a better city has been well illustrated in Spokane, Wash., where the principal business thoroughfares in a district half a mile (0.8 km.) long and a quarter of a mile (0.4 km.) wide are now brilliantly lighted. From dusk until daylight 400 luminous arcs of the latest pattern diffuse white light so thoroughly that fine print may be read with ease at any point in the illuminated section. Shadows are banished, there are no dark corners, and the distribution is so unobtrusive that one does not look for the lamps which cause it, accepting the condition without a thought of its source.

Along with the new illumination has come a change in the aspect of the streets. Buildings which formerly had relatively good "store fronts" have been remodeled and provided with more attractive street faces. Signs have been reduced in size and made more uniform. Window lettering is neater and more artistic. Displays are arranged more attractively. The streets are better kept.

All this improvement has resulted because the strong white light at night brings out pitilessly every detail. Disarray, if permitted in a window, seems emphasized. Dirt cannot be hidden. An inartistic sign is hideous. These things are not so noticeable during the daylight hours when every one is in a hurry and the rush of traffic keeps persons watching their step for safety. But at night travel slows up. Citizens take time to study window showings. Displays draw more attention.

Salespeople frequently are greeted in the morning with "I saw in your window last night an article," etc., indicating that the shopping trips are frequently induced by a stroll past well-lighted windows on the previous evening. Another effect of the illumination is noted in the appearance of the night crowds. Women feel secure from annoyance and promenade the business district in greater numbers than before the new lighting was adopted. Feeling more on exhibition than formerly, they are more careful of attire. Men are affected the same way. Furthermore, the oldtime corner loafers and parasites are seeking shadows and obscurity for their comfort. The chief of police has summed the situation up thus:

"Few people realize how much peace and order depend upon lights. We have fewer and fewer calls from the downtown district since the installation of the illuminating system. Disorder, crime, immorality and darkness go together."

ELECTROLIER CURB LIGHTING ON FIRST AVENUE

The first test of the new illumination began four years ago, when curb electroliers were installed at intervals of 100 ft. (30.5 m.) along the east end of Riverside Avenue for a distance of four blocks. Since then the whole length of Riverside in the business section and all of First, Main, Sprague and Trent Streets have been included. Now the merchants on cross streets are demanding similar improvements.

The illumination is provided by General Electric luminous magnetite arc lamps rated at 6.6 amp. A soft white light is produced with no sputtering. The system has been a complete success from the start. The cost is $75 per year for each electrolier, covering installation, energy and maintenance. Property owners pay three-fourths and the city one-fourth of the expense. At the end of ten years the city will assume the title to the equipment. Power for the lighting, also for street car service, manufacturing and domestic use, is obtained from the falls of the Spokane River through the Washington Water Power Company, of which John B. Fisken is superintendent of light and power.

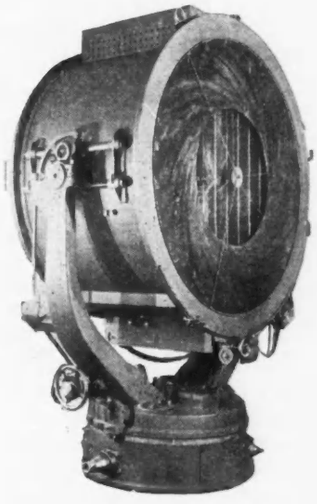
RIVERSIDE AVENUE AT 3 A. M. NEWSPAPERS MAY BE READ WITH EASE AT ANY POINT

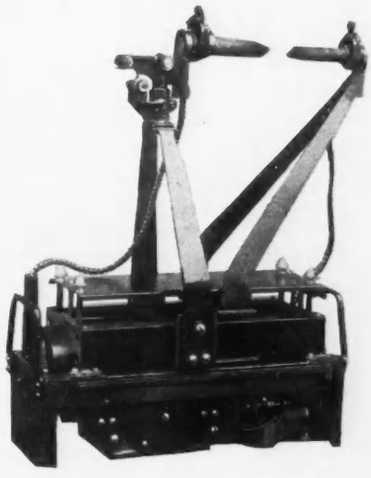
Characteristics and Testing of War Searchlamps

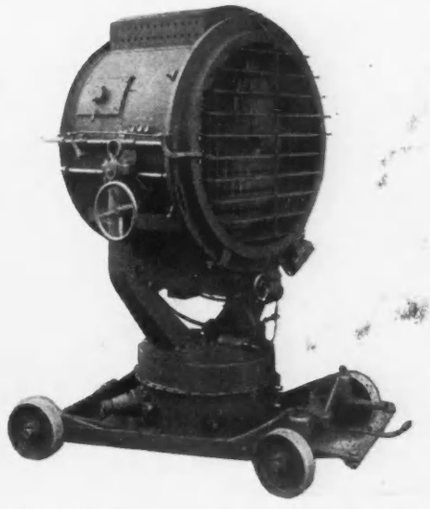
Sizes of Electrodes for Different-Diameter Projectors, Relation of Focal Length to Diameter of Mirror, Difficulties in Measuring Beam Candle-power, and Other Points of Interest

BY LIEUT. SAMUEL G. HIBBEN

SINCE the beginning of the war great forward steps have been taken by American manufacturers in the detailed development and manufacture of searchlamps for use in foreign countries as well as in the United States. Higher efficiencies have been gained by using higher current densities in cored carbons, and the accessories and control mechanisms have been developed at a very rapid rate. Shown in the accompanying illustrations are views of semi-portable searchlamps, one representing the type most common on the United States battleships and the other the kind used in coast defense work. The latter is equipped with a 60-in. (1.52-m.) reflector and stands 12 ft. (3.7 m.) high. Operating at the usual 20,000 watts demand, it will project a beam of a possible 200,000,000 cp. Motors with distant control are geared to elevate and depress the projector or revolve the barrel about the vertical axis. Hand-wheels are provided to perform the same operation and to set the electrodes in the proper relative positions.







FIGS. 1, 2 AND 3—SEARCHLAMP (60-IN.) WITH IRIS SHUTTER PARTLY OPENED; MOTOR-DRIVEN ARC-FEED MECHANISM, AND 36-IN. SEARCHLAMP MOUNTED ON TRUCK

The arc mechanism is particularly interesting in that it maintains the carbon electrodes in proper alignment and keeps the arc crater at the exact focal point of the mirror. Carbon electrodes with hard casings and soft carbon cores are employed, the materials being selected so that they burn at the same rate without slagging. The sizes approved by the United States Navy for different diameter projectors are indicated in the table. The average life of the carbon electrodes used in the 60-in. (1.5-m.) projectors is about six hours.

Searchlamps used on the battleships are connected directly with the direct-current service lines, with the proper balancing resistance in series, but for coast defense and semi-permanent fortifications a self-contained generator set such as shown herewith is provided. A control box is located at some convenient point between the generator and the projector so that the back-glare from the moisture and dust in the atmosphere will not interfere with the operator's view of the distant target.

Owing to the operating conditions to which searchlamps are subjected, it is more important that they be reliable in operation than that they be efficient. In the first place the generator units are subject to rough operating conditions and must start readily in rain and cold weather, or operate in hot places without excessive attention. A 25-kw. unit will consume about 6 gal. (22.7 l.) of gasoline per hour.

Certain relations usually exist between the arc current and the size of the mirror used with that arc. The practical relationship so far used in the projectors manufactured in this country is shown in Fig. 5. Of course, the arc voltage remains practically constant, according to the characteristic of the direct-current arc, so that for the arcs of greater candle-power or of greater wattage the amperes will be increased. In a typical 60-in. (1.5-m.) projector the arc voltage is about 55 and the current nearly 180 amp. As with any other direct-current arc, an automatic balancing resistance is used in the circuit to maintain a constant arc voltage.

The ratio of diameter of mirror to focal length is practically a straight-line function, as shown by the dotted line in Fig. 5. The simplest practical way of determining the focal length is to place the mirror with the plane of its opening normal to the sun's rays. Then, if the atmosphere is slightly foggy or clouded with smoke or dust, the rays concentrate at the focal point.

The present state of glass manufacture is such that the size of the Mangin mirrors for large projectors is limited by the prohibitive cost and liability to breakage of anything in excess of 60-in. (1.5-m.) diameter. The focal length cannot be too short, otherwise the mirror will be endangered by heat of the arc. The greater the focal length the less the dispersion, but opposing this is the fact that with greater focal length less light from the arc strikes the mirror. Without going into the theory of the problem of the best mirrors, it is sufficient to note that the dispersion is greatest when the ratio of crater area to focal length is greatest: hence to secure a long-range beam from a large candlepower arc it is necessary to use a correspondingly large mirror. Thus for a ¾-in. (19-mm.) diameter arc crater, a 36-in. (0.9-m.) mirror with a 15-in. (38.1-cm.) focal length is used, and the minimum dispersion either side of the axis of the beam will be the angle whose tangent is $\frac{3}{8} \div 15$, or 1.5 deg.

There will, of course, be some dispersion caused by the front glass. The absorption loss in the mirror and the front glass taken together is somewhere in the neighborhood of 20 per cent.

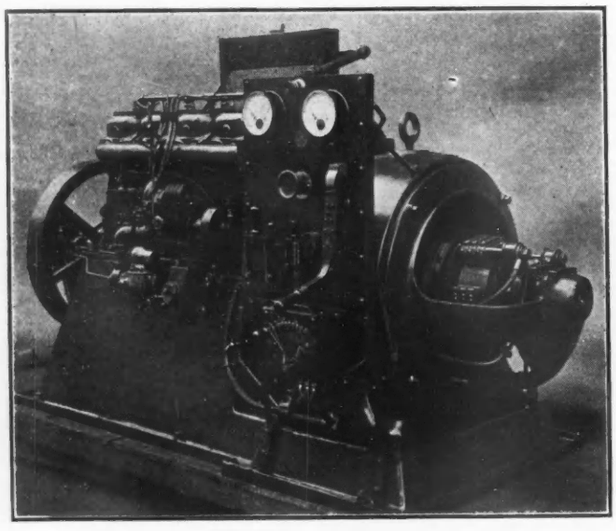


FIG. 4—GASOLINE-ENGINE-DRIVEN GENERATOR FOR SEMI-PERMANENT SEARCHLAMPS

Arc and Beam Candlepower

The final criterion of the efficiency of a searchlamp is the candlepower and homeogeneity of the projected beam, and these values are difficult to determine. Considering only the arc it is possible to photometer the light source and secure results as shown by Figs. 7 and 8. The crater of the positive carbon is the light source, and this for the 60-in. (1.5-m.) projector measures 0.9 in. to 1.2 in. (2.29 cm. to 3.04 cm.) diameter. The maximum candlepower is at about the 45-deg. angle to the negative carbon, just before the point where the tip of the negative carbon begins to cut off the full view of the crater. Under normal operations the arc current lies between 160 amp. and 180 amp. for the largest units; hence the maximum effective crater candlepower is, say, 50,000. This is equivalent to more than 80,000 cp. per sq. in. (12,400 cp. per sq. cm.) of light source—much the brightest of all sources of light yet produced by man.

If there were no dispersion of the beam, which in practice is caused by the considerable size of the light source and by inaccuracies of the mirror, and if atmospheric absorption were negligible, then the measurement of the beam candlepower would be a simple matter, as it could be determined by reading the candlepower at any convenient distance. However, these factors cannot be eliminated and the law of inverse squares will not apply. Approximate values of beam candlepower can be obtained, however, without taking into account the magnifying power of the mirror or the atmospheric and glassware absorption by the following formula:

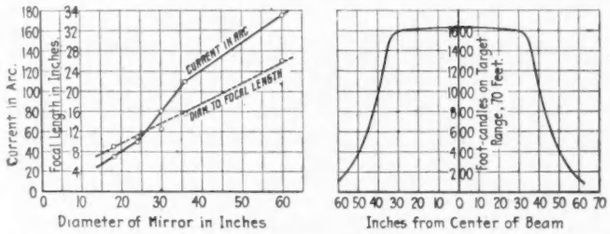
$$I = X\frac{(d^2)}{(c^2)},$$

where

I = intensity of projected beam of light,
X = intensity of light striking mirror,
d = diameter of mirror in feet,
c = diameter of arc crater in feet.

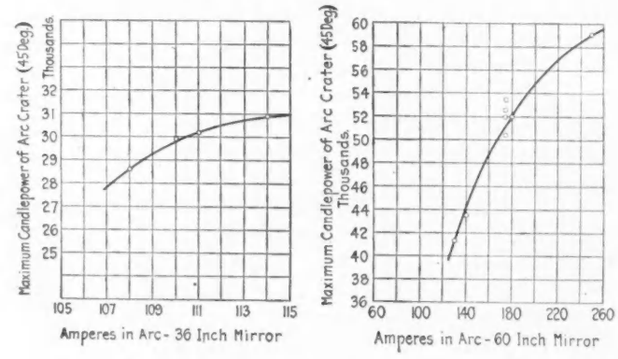
If this formula be applied to the 60-in. (1.5-m.) projector with an arc crater of 1.1 in. (2.8 cm.), and the average intensity of light incident on the mirror be taken as approximately 49,000 cp., then the beam candlepower would be about 151,000,000.

A much better way of comparing searchlamp efficiencies is to measure the foot-candles on a target at some standard distance and under similar atmospheric conditions. The arc, of course, should be focused to have the illuminated area of the target the same as the area of the mirror. The results of one set of measurements of this kind are given in Fig. 6.


Current in Arc.
Focal Length in Inches.
CURRENT IN ARC
DIAM. TO FOCAL LENGTH
Diameter of Mirror in Inches
Foot candles on Target Range, 70 Feet.
Inches from Center of Beam

FIGS. 5 AND 6—RELATIONS BETWEEN MIRROR CHARACTERISTICS AND ARC CURRENT; TARGET ILLUMINATION PRODUCED AT 70 FT. WITH 60-IN. PROJECTOR

The quantity of light is directly proportional to the area of the crater, and this area, or the diameter of the carbon, is governed by the current. The temperature of the positive arc crater is from 4000 deg. to 6000 deg. C., and for excessive current densities the carbon holders must be specially cooled.



FIGS. 7 AND 8—RELATION OF ARC CURRENT TO CANDLEPOWER IN 36-IN. AND 60-IN. PROJECTORS

In naval service particularly, and to a lesser degree in field operations, the loss of light in atmospheric absorption is great, usually sufficient to make the searchlamp ineffective at ranges of much over 6000 yd. (5486.4 m.). The ranges at which targets of gray or

SIZES OF ELECTRODES FOR DIFFERENT DIAMETER PROJECTORS

Projector, inches	Negative Carbon, inches	Positive Carbon, inches
18	5/8, solid	1 1/8, cored
24	3/4, cored	1, cored
30	7/8, cored	1 1/8, cored
36	1, cored	1 1/4, cored
60	1 3/8 cored	2, cored

medium light colors may be satisfactorily illuminated by a 60-in. (1.5-m.) searchlamp are as follows:

	Yards
With very clear atmosphere	10,000 or more (9144 m.)
With average atmosphere	6,000 to 8,000 (5,486 to 7,315 m.)
Through slight haze or rain	3,000 to 4,000 (2,743 to 3,657 m.)
Fog or early dawn	1,000 to 2,000 (914 to 1,828 m.)

Cases are known, however, where vessels have been observed at a distance of 9 miles (14.5 km.), and on slightly foggy nights the beams may be seen in the sky at still greater distances. No definite values are set for target illumination. If a small projector, say one with an 18.4-in. (45.7-cm.) mirror, is used in sweeping the sky for aircraft, the object may be detected with less than 1 ft.-candle (10.8 lumens per sq. m.) of illumination. For a range of 2730 ft. (892 m.) the arc current and corresponding illumination intensities on the target are as follows:

Current in Arc (amp.)	Intensity on Target	
	Foot-Candles	Lumens per Sq. M.
20	0.4	4.3
25	0.7	7.5
40	0.9	9.7
60	1.0	10.8
90	1.0	10.8

From experience it has been found that it is best to illuminate as little of the foreground and surroundings as possible to minimize back glare and avoid disclosing to the enemy even the smallest portion of the searchlamp location. Gun lights—that is, lamps used in illuminating targets on which guns are being trained—should be mounted 90 ft. to 100 ft. (27.4 m. to 30.5 m.) above the water and searching lamps at not less than 25 ft. (7.6 m.). The most favorable direction of the beam of light is found to be 30 deg. with the line of fire.

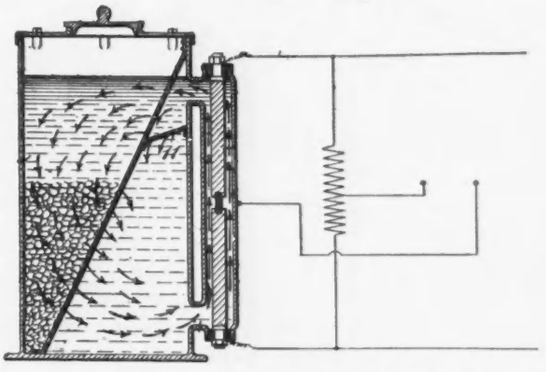
It is interesting to note that the searchlamp may be used effectively both on sea and land for signaling, using the Morse telegraphic code interpreted by flashes of light. The beam is turned toward the receiving station and cannot be observed a few degrees either side of the object upon which it is trained. The signaling is done in much the same manner as with a heliograph, and in daytime can be performed at a range of 6 miles to 8 miles (9.7 km. to 12.9 km.).

In the opinion of the writer even the exigencies of the present war will scarcely call forth any very radical improvements in searchlamp construction, except of the arc and its mechanism. Developments are under way to increase the current density of the carbon tips and arc stream, and these promise to increase the efficiency by decreasing dispersion; that is, securing more nearly the ideal point of light source.

ELECTROLYTIC RECTIFIER

Solution Kept Saturated at All Times and Maximum Conductivity Retained

To overcome the objections raised to the use of mechanical rectifiers it is contemplated by Charles C. Ruprecht of Midway, Fla., in patent No. 1,223,114, to use means whereby the salts or chemicals in excess of the saturation point will be disposed in the circulatory current in the electrolyte. This will cause the solution to be kept saturated at all times and maintain its maximum conductivity both of heat and electricity. The



PLAN OF ELECTROLYTIC RECEIVER SHOWING CIRCULATORY PATH OF SOLUTION

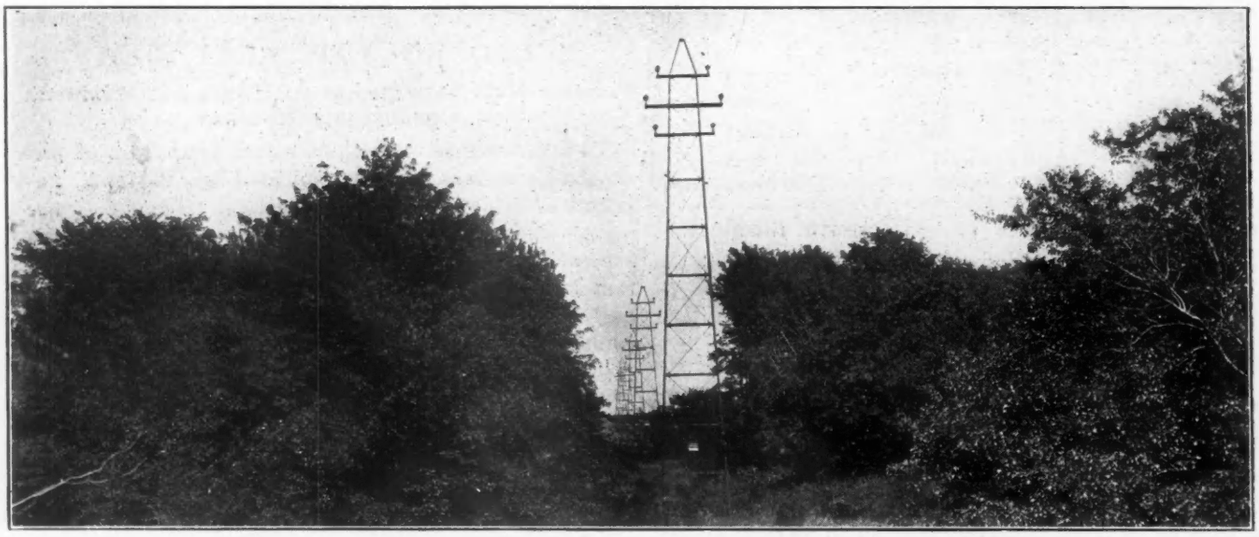
rectification is also maintained practically at a constant efficiency, and a constant combination of the salts with the solvent tends to cool the solution. This helps to maintain the rectifier in its best working condition. The placing of the salts in the circulatory path of the solution and away from the active electrodes causes recrystallization of the salt on the mother crystals in the receptacle or retainer and not at the electrode or any other place where they would detrimentally affect the working of the instrument.

National Research Laboratory Recommended for France

The French Academy of Sciences recently passed unanimously the following resolution: "The Academy of Sciences, convinced of the necessity of organizing in France certain scientific researches in a systematic manner, recommends that a National Laboratory of Physics and Mechanics be created, especially devoted to scientific researches useful for the progress of industries. This laboratory should be under the direction and control of the Academy of Sciences, one-half of the council to consist of scientists designated by the Academy, one-quarter of representatives of government scientific bureaus, and the remaining quarter to represent the principal industrial associations."

Interconnection a Boon to New England Plants

How an Overloaded Plant, One That Had Ample Generating Facilities and One That Had a Poor Load Factor Were Mutually Benefited by a Tie Line



VIEW ALONG RIGHT-OF-WAY OF TIE LINE CONNECTING THREE MASSACHUSETTS PLANTS

WHILE the interconnection of generating plants has always been an advantage even in normal times, it is still more important right now because of the unusual necessity of operating economy which it permits. Foremost among the benefits of interconnection are the advantage which can be taken of the system diversity factor and the possibility of using all equipment to the maximum extent and with the best economy. A striking example of the benefits to be derived from co-ordinating generating facilities is afforded by a group of New England companies which have been recently interconnected. This group comprises the Salem Electric Lighting Company, the Malden Electric Company and the Suburban Gas & Electric Company of Revere, which are among the most important suburban central stations in the Boston district. These companies are under the management of Charles H. Tenney & Company of Boston. The transmission tie line was constructed by the Eastern Massachusetts Electric Company, an organization affiliated with the Tenney interests.

The plant of the Salem company is most favorably located as regards coal delivery and condensing water supply. Situated on tidewater, near the center of the Salem business and manufacturing district, this plant has lately undergone a substantial development in the direction of capacity increase.

The Malden station is situated in a city district where expansion of the plant is virtually prohibited. Coal cannot be delivered by water and condensing water is expensive on this site. The plant is an inland station, with all the disadvantages implied by such a location. The station of the Revere company, on the other hand, is a relatively small plant, far removed from the important load centers of the Salem and Malden companies and not well located with respect to development into a plant of great magnitude. This last plant serves an enormous summer resort patronage in addition to a wide area occupied by year-around residents.

Investigation of the best means of providing additional equipment to meet the growing demands upon these companies showed the engineers of the Tenney organization that the situation was peculiarly well suited to the construction of a tie line. It was decided to develop the Salem plant as the main source of supply, this station having practically unlimited development possibilities, with ample facilities for coal storage. The plan contemplated the sale of electricity to the Eastern Massachusetts Electric Company, which in turn markets

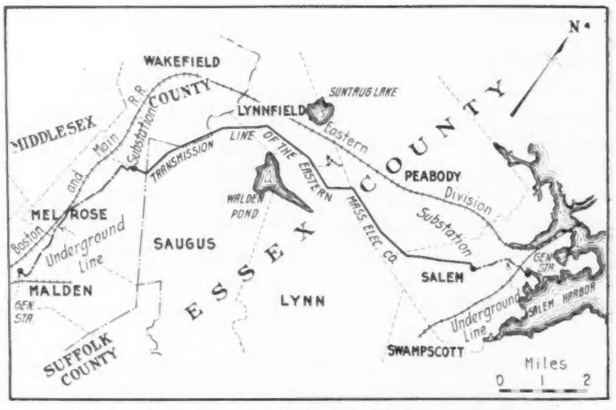
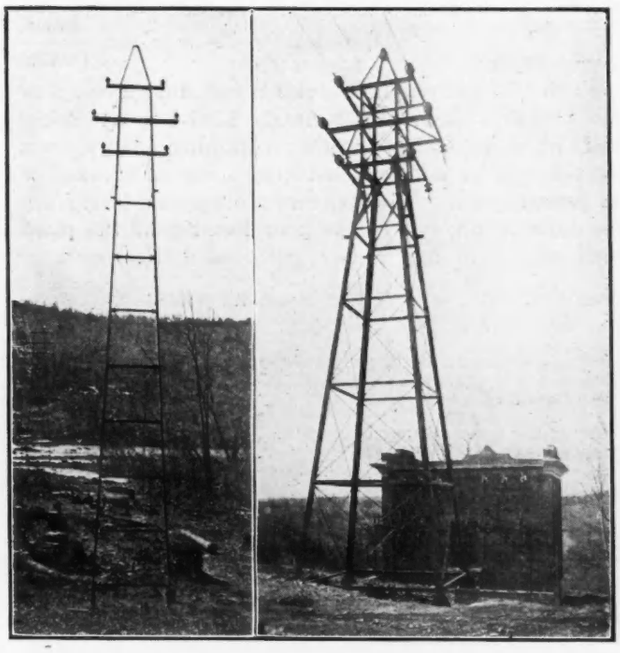


FIG. 1—ROUTE OF LINE FROM SALEM TO MALDEN

this energy to the Malden and Revere companies, enabling the latter to purchase energy at a price representing a saving over their present production cost, and permitting them to take on increased business without making further capital investment in their plants. Such an investment would otherwise have become neces-

sary at a very early date if the tie line had not been installed.

The establishment of the tie line enables either the Malden or the Revere company to operate its present plant at an economical point at certain times during the year, and to sell energy to the Salem company if the load conditions warrant. The new line ties the three



FIGS. 2 AND 3—MALDEN-SALEM TIE LINE; MELROSE TERMINAL, EAST SIDE

plants together electrically, so that in a sense they constitute units of a single plant, with all the distinct advantages arising from the combination of diversity factors, resulting in much more economical operation for each individual plant. The line was placed in service May 1, 1917, and the results of its service have come very close to the estimated figures upon which its construction was based, and which are made available for the ELECTRICAL WORLD through the courtesy of A. B. Tenney, vice-president of Charles H. Tenney & Company.

The route followed by the line from Salem to Malden is shown in Fig. 1. Underground cables were laid from the Malden plant to a terminal house in Melrose. From thence the line is carried on Archbold-Brady A-frame towers over a 40-ft. (12-m.) right-of-way to a terminal house in Salem, the last part of the run from the latter point to the Salem generating station being underground. Two 22,000-volt circuits are carried from Malden to Salem. The overhead conductors are No. 2/0 copper, seven-strand cables, a 5/16-in. (7.9-mm.) Siemens-Martin stranded steel cable being used for the ground wire. The length of the tower line is 9.54 miles (15.35 km.). From the Malden station to the Melrose terminal house 43,000 ft. (13,106 m.) of three-conductor, lead-covered cable is installed, the lead sheath being ⅛ in. (3.2 mm.) thick and varnished-cambric insulation 9/32 in. (7.2 mm.) thick. In Salem 17,000 ft. (5181 m.) of cable were installed, and between Malden and Revere 45,950 ft. (14,000 m.) of cable are in service, this entire line being underground and supplementing a tie line between Malden and Revere which has been in service for several years.

On the overhead line between Melrose and Salem the average tower spacing is 450 ft. (137 m.). All buried portions of the towers are galvanized. The rating of the line is 10,000 kw. at 22,000 volts. One hundred and fifty steel towers were required.

Cost of construction and cost of fuel have both risen since the erection of the line was begun, but the economic justification of the line appears from the data published. On Dec. 23, 1915, the peak loads on these stations were 5200 kw. at Salem, 3430 kw. at Malden, and 1080 kw. at Revere. Since the generating capacity available was 17,000 kw. at Salem, 3400 kw. at Malden and 1400 kw. at Revere, the Salem plant was operating at less than one-third of its rating, the Malden station was slightly overloaded and the Revere plant was about three-quarters loaded. The peak load on the last-mentioned station, however, came at 8 p. m., whereas the peaks on the two other stations occurred at 5 p. m. The Salem plant had the poorest load factor of the three, although it is the most modern station. Typical summer load conditions also show the Salem plant at a disadvantage with respect to Malden, but the Revere station had the poorest load factor of the three.

The inability of the Malden station to meet the estimated 1916 load requirements and the close approach of the Revere load to the capacity of the plant are indicated in Fig. 6, the typical summer conditions for 1916 being shown in Fig. 7. It will be seen that the use of a tie line permits handling the 1916 winter load (Fig. 6) on the Salem station alone if need be, whereas if the Malden plant had been forced to depend upon itself its rating would not have been sufficient to meet the demand upon it by about 1495 kw. Revere in 1916 came close to its rating, with little or no reserve. The influence of the power load on Salem and Malden is apparent from Fig. 7, the peak occurring at 11 a. m. in these stations. This means that advantage can be taken of the diversity factor with respect to Revere under the

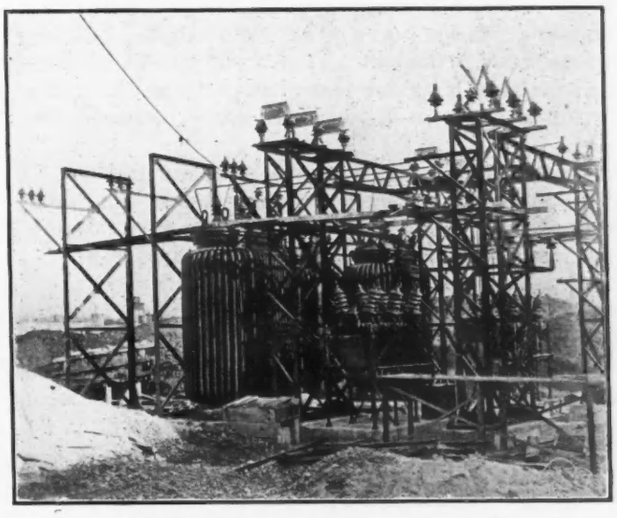


FIG. 4—SALEM OUTDOOR SUBSTATION

operation of the tie line, and this is done. Full benefit of the tie line, of course, requires the installation of sufficient transformer capacity at the step-up and step-down ends of the line. A chart of the kilowatt-hours produced each month in 1915 by the three stations, and including a totalizing curve assuming all the output handled by the Salem plant, is shown in Fig. 8.

The following data and analysis give the basis for establishing a selling price for the energy supplied to and sold by the transmission company, and show the

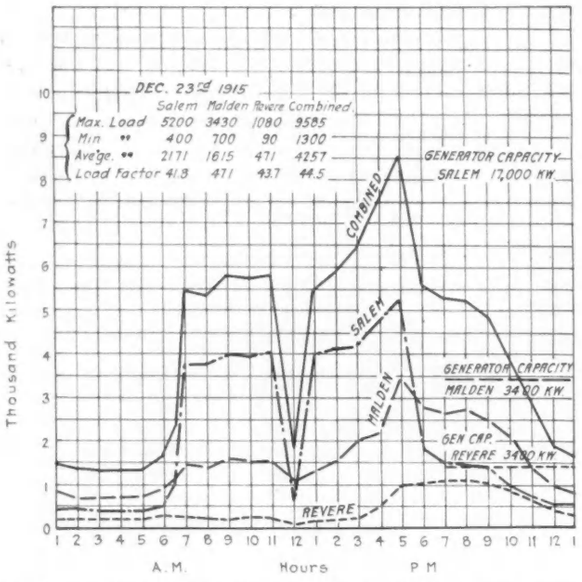


FIG. 5—RELATION OF LOADS IN SALEM, MALDEN AND REVERE STATIONS TO GENERATING CAPACITY IN WINTER OF 1917

saving realized by each company by interconnection:

PRODUCTION COST* OF SALEM COMPANY, 1916 BASIS

	Per Kw.-hr.
Fuel	$0.005000
Fuel handling	0.000095
Water	0.000240
Lubricants	0.000100
Total	$0.005435
Plus 10 per cent profit	0.000543
Total	$0.005978

This establishes a selling price to the transmission company of $0.006. Annual output of Malden company at switchboard (salable) = 10,000,000 kw.-hr. Assuming a line and transfer loss of 8 per cent, the transmission company is obliged to purchase for the Malden company 10,800,000 kw.-hr.

The Revere company's output at its switchboard is 3,500,000 kw.-hr. yearly. Assuming a line and transformer loss of 10 per cent, the transmission company must buy for the Revere company 3,850,000 kw.-hr.

	Kw.-hr.
Total energy purchased by transmission company	14,650,000
Total energy sold by transmission company	13,500,000

By purchasing all the above energy from the Salem company at $0.006 per kw.-hr., it would pay the Salem company $67,900 and the latter would make a profit on this of $0.000565 per kw.-hr., or $8,277.25.

MALDEN ELECTRIC COMPANY COSTS, 1915 BASIS

	Per Kw.-hr.
Total production cost of energy at Malden	$0.01050
Estimated† cost of purchased energy	0.00985
Saving per kilowatt-hour	$0.00065

Or $7,200 per year.

*Fixed charges were not included in establishing the billing price of energy generated at Salem because it was unnecessary to make any additional investment in generating apparatus or to increase the payroll in order to supply the tie line.

†The estimated cost of purchased energy is the amount paid the transmission company plus expense of running distributing station.

The estimated† cost of purchased energy included the following items of station operation at Malden:

Station superintendence and care	$2,000
Three switchboard men	3,120
Two extra men	1,560
Fuel	500
Light and miscellaneous expenses	500
Repairs	1,500
Total	$9,180
Unit cost per kw.-hr. on production of 10,800,000 kw.-hr.	$0.00085
Cost of purchased energy	0.00900
Total, as above	$0.00985

At the time of the investigation the Malden company had signed a contract for nearly 1000 kw. additional load, which necessitated either obtaining energy from some source or adding considerable capital account to its present plant. The latter course appeared very undesirable on account of the poor location of the plant with respect to fuel supply and condensing water.

SUBURBAN GAS & ELECTRIC COMPANY (REVERE) COSTS

	Per Kw.-hr.
Total cost of energy at Revere station, 1915 basis	$0.01460
Estimated cost of purchased energy	0.01383
Cost of purchased energy	0.01150
Saving per kilowatt-hour	$0.00077

Or an annual saving of $2,695.

The above estimated† cost of purchased energy is made up on the basis of figures used for the Malden Electric Company, with a deduction of $250 for fuel used in heating and of $750 for repairs, making a total

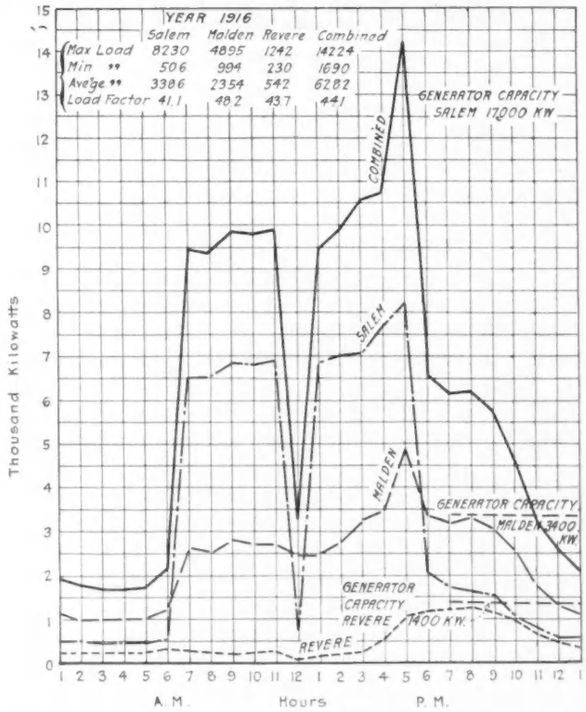


FIG. 6—RELATION OF LOAD AT EACH INTERCONNECTED STATION TO GENERATOR CAPACITY IN 1916

of $8,170, which represents a part of the production cost at Revere when energy is purchased.

	Per Kw.-hr.
For a production of 3,500,000 kw.-hr., at $8,180, the unit cost comes to	$0.00233
Total	$0.01383

The load conditions at the Revere station were approximately 1900 kw. and its normal rating 1440 kw.

Prior to the construction of the transmission tie line between Malden and Salem energy was purchased from the Malden company by the Revere company to take

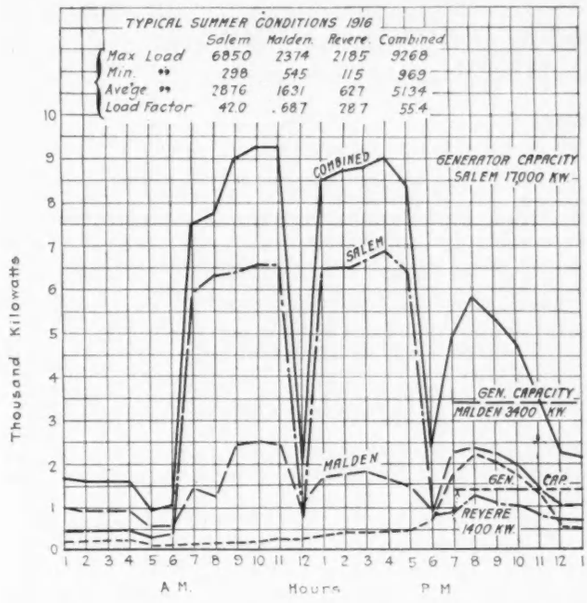


FIG. 7—RELATION OF LOADS TO GENERATING CAPACITY IN SUMMER OF 1916

care of the overload conditions during the summer months; but, as stated under the Malden conditions, the load of the Malden company would shortly have made it impossible for it to continue to assist the Revere company in this way. As the Salem company during the summer has surplus capacity, it is in an excellent position to relieve both the Revere and Malden plants at the same time, eliminating the need of a large additional investment at the Revere plant no less than at Malden. At Revere an aqueduct would have had to be constructed had energy not been purchased from Salem or an equivalent source of large capacity.

As the contracts for line material were placed some time before the present extreme prices were in force, steel towers, for example, being bought at 3.65 cents per pound (8.03 cents per kg.), the cost of the line was far below the cost of present construction. Copper was purchased for this line at the low figure of 18.47 cents per pound (40.63 cents per kg.), and the three-conductor, lead-covered transmission cable was purchased at a price of $1.297 per foot ($3.891 per m.). The main items of cost were:

COST OF LINE

Structural line material (towers, about 500,000 lb.)		$18,250
Foundations (concrete or steel grid, according to location)		3,300
Labor of erection (towers and conductors)		8,800
Conductors and transmission material (overhead), including 800 insulators and stranded steel ground cable		29,000
Miscellaneous overhead fixtures, guys, disconnecting switches, etc.		3,300
Underground transmission line, including 25,000-volt cable on Malden-Salem route and 45,950 ft. 2/0 15,000-volt three-conductor cable on Malden-Revere route:		
Malden-Melrose terminal house cable (43,000 ft.)	$55,771	
Transportation and installation	6,000	
		61,771
Salem-Highland Avenue terminal house cable (17,000 ft.)	$22,049	
Transportation and installation	3,000	
		25,049
Malden-Revere cable (45,950 ft.)	$48,053	
Transportation and installation	5,143	
		$53,196
Contingencies and incidentals—5 per cent		10,133
Engineering services—5 per cent		10,639
Legal, drafting agreements, etc.		1,500
Rights-of-way		28,851
Total		$253,791

NET INCOME† FROM TIE-LINE SERVICE

Revenue:		
Malden company, 10,000,000 kw.-hr. at $0.009		$90,000
Revere company, 3,500,000 kw.-hr. at $0.0115		40,250
Total		$130,250
Operating Expenses:		
Energy purchased by transmission company from Salem, 14,650,000 kw.-hr. at $0.006	$87,900	
Labor	8,000	
Repairs	1,000	
Taxes, 2.5 per cent on $200,000	5,000	
Insurance—fire, employees, public	1,000	
Depreciation on $200,000 at 5 per cent	10,000	
Interest on $250,000 at 6 per cent	15,000	127,900
Net income of transmission company		$2,350

†Income based on taking transmission line investment at $250,000.

From the foregoing analysis it appears that the profit to the Salem company on the sale of energy to the tie-line company (Eastern Massachusetts Electric Company) is $8,277 per year; the Eastern Massachusetts company makes $2,350; the Malden company saves $7,200, and the Revere company saves $2,695 over its costs on the basis of the expenses analyzed. At least $20,522 per year is therefore made by the tie line, taking its entire cost into account. At present the

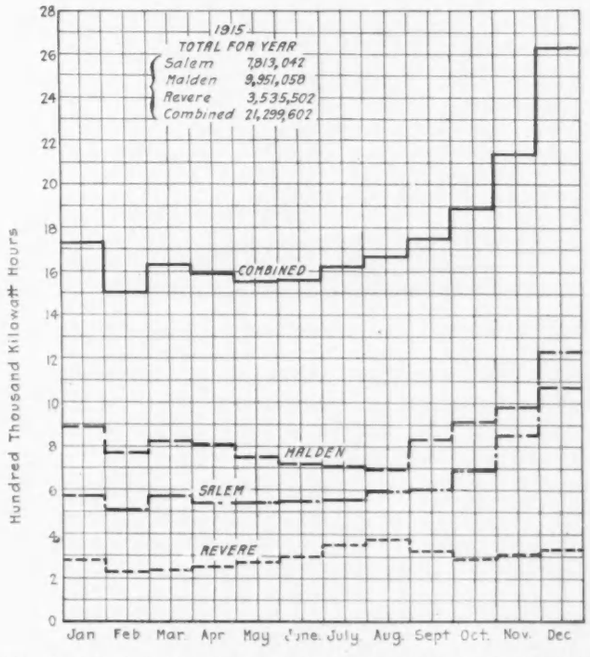


FIG. 8—ENERGY OUTPUT OF THE INTERCONNECTED STATIONS FOR YEAR OF 1915

Malden station is being operated at a fixed load of 750 kw. from Monday morning to 11 p. m. Saturdays. The Revere station is being run daily except Sunday from 4 to 11 p. m. at 550 kw. The Salem station is run continuously, and the June, 1917, peak was 8200 kw. The output at Salem in June was 2,500,000 kw.-hr., the load factor being 42.5 per cent and the fuel consumption 1.9 lb. per kilowatt-hour.

Testing Insulators to Assure Continuous Service

Portable Outfit Consisting of Gasoline-Engine-Driven Alternator Connected with Oscillator Used by Pacific Coast Company for Weeding Out Defective Insulators—Cracking Under Cap Found to Be Most Frequent Trouble

BY R. W. SORENSEN
Professor of Electrical Engineering, Throop College of Technology, Pasadena, Cal.

EXPERIENCES of power companies have indicated that the porcelain line insulator is by no means a permanently reliable piece of equipment. Since the failure of only a small percentage of the insulators along a line will lower very considerably the large factor of safety obtainable when the line is new, the possibility of service interruption will be greatly increased unless provision is made for periodic testing of the insulators and the renewal of the units found defective.

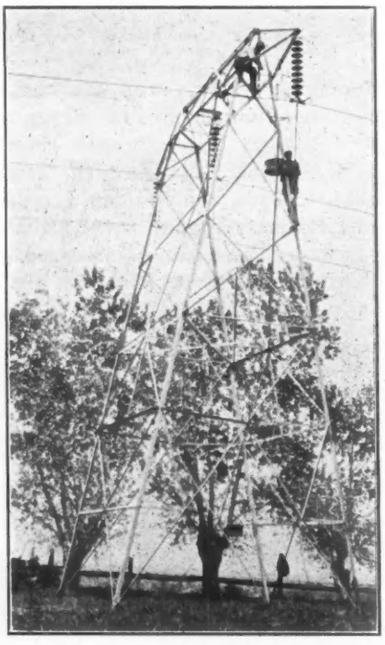


FIG. 1—FIVE-MAN CREW TESTING SUSPENSION INSULATORS

To forestall any trouble from insulator depreciation the engineering department of the Pacific Light & Power Corporation, in co-operation with the author, some time ago undertook the development of a system of testing and maintaining porcelain insulators. In developing the testing method finally adopted an analysis was made of the relative values of tests by megger, high potential and any other possible means which might be developed. Special attention was directed toward securing a field method more rigorous than that utilizing the megger and permitting the use of equipment more portable than required for low-frequency, high-potential arc-over tests. One apparent method of accomplishing the desired results was to develop a portable high-frequency testing outfit which could be used in conjunction with an induction coil.

To determine the relative values of the available test methods a station was established near one of the transmission lines to be studied and a number of insulators were brought in from the lines for test. These insulators, all of which were suspension units of a well-known make, were divided into four groups according to the tests which they were to receive. The units of group I were tested by megger, oscillator and high potential; those of group II by megger, induction coil and high potential; group III by megger, oscillator, induction coil and high potential; group IV by megger, induction coil, oscillator and high potential.

TABLE I—DATA ON INSULATOR TESTS

Group No.	Units Tested		Units Defective by Megger Test		Units Defective by Oscillator		Induction Coi		50 Cycle 55 Kv. Applied 1 Min.	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
I	577	100	47	8.2	62	10.8			88	15.2
II	676	100	83	12.2			136	20.1	160	24.0
III	143	100	0	.0	2	1.4	3	2.1	3	2.1
IV	150	100	.0	.0	3	2.0	2	1.3	3	2.0
V	1048	100	100	9.5	142	13.5			*167	*15.9

*50-cycle arc-over voltage.

A study of the results obtained, combined with the knowledge that a much more efficient high-frequency oscillator than the one used in these tests (which was the simplest kind of a Tesla coil) could be built, led to the construction of a portable oscillator (Fig. 2) for testing insulators along the line. With this apparatus another lot of insulators designated as group V in Table I were tested in the same manner as those of group I. In testing group V it was noted that there were no immediate failures of insulators which passed the perfected oscillator when subjected to the arc-over voltage at 50 cycles. Furthermore, the failures occurring under this test within a minute were not greatly in excess of those obtained with the oscillator.

TABLE II—RESULTS OF TESTS ON THREE WOOD-POLE LINES

Total length of lines	88.8 miles
Type of insulator	Suspension
Character of country in which insulators were installed	Low rolling hills, dry and sandy, free from lightning, but subject to some fog and rain; no snow, sleet or high wind.
Total number of units in lines	25,234
Number of units found defective with megger at end of first year's operation	1,633
Number of units found defective after three years' operation by megger, oscillator and high-potential tests	4,045
Total number of units defective since building of line	5,678
Percentage of units found defective by megger at end of first year's operation	6.5
Total percentage of units defective after three years of operation	22.4
Average loss per year in per cent	7.5

The oscillator was therefore adopted as a standard means of testing and the insulators on three wood-pole lines were taken down and tested, with the results shown in Table II. Two of these lines had four units in sus-

pension strings and five units on dead-ends and had operated about three and a half years at 60,000 volts. The other line had three units in suspension strings and four units on dead-ends and had been operating two and a half years at 15,000 volts. The results of these tests have been grouped together in Table II, because they were practically the same for all three lines and no advantage is gained by segregating them.

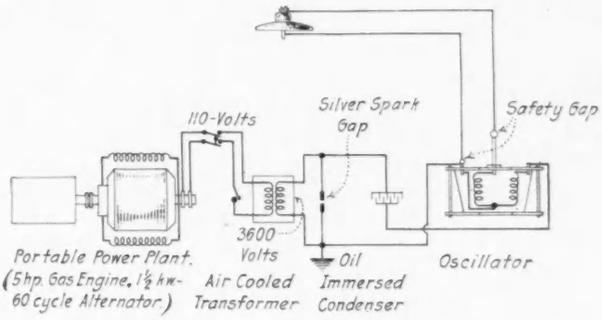


FIG. 2—CONNECTIONS OF PORTABLE HIGH-FREQUENCY INSULATOR TESTER

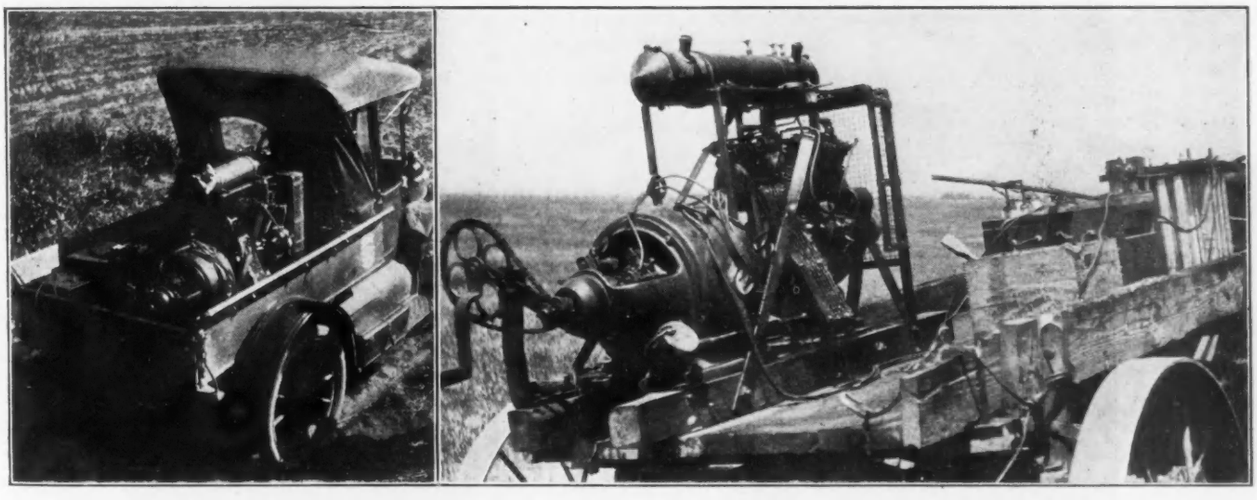
The testing plant consisted of an oscillator set developed and made in the shops of the Pacific Light & Power Corporation, according to plans of the author, and a portable power plant for furnishing energy when away from stations where electric energy at a potential of 110 volts was readily obtained. The entire equipment, including portable power plant as connected for operation, is shown diagrammatically in Fig. 2.

The oscillator was wound with many layers having a few turns per layer to give efficient coupling between the primary and secondary coils and is immersed in a small tub called a "keeler," which is filled with transformer oil. The condenser is made of pressboard and sheet copper or steel, according to which is available, and is inclosed in a tank filled with transformer oil. The spark gap is a stationary gap consisting of two silver bars 1 in. (2.54 cm.) long and 1/16 in. (15.9 mm.) thick. The transformer is of the natural-cooled, air-insulated type wound to have a very high reactance so as to limit the current at short circuit. On the high-tension side it is equipped with air-core reactors to protect the windings from the surges set up during the operation of the oscillator. The portable power plant consists of a twin motorcycle engine directly connected to an alternator made by equipping a 3-hp., 220-volt direct-current motor with collector rings, the commutator being left on the machine to furnish excitation.

The entire testing outfit was developed along lines which would permit its being used for testing insulators without removing them from the line towers or poles. At present it is being used in this manner, as will be seen from the self-explanatory photographs shown in Figs. 1, 5, 6, 7 and 8. It was not so used on the wood-pole lines for which data are given in Table II, because it was easy to change the comparatively few units on a pole, and also because it was necessary to change one or more units in so many of the strings that there was a gain in economy in taking down all units. This condition could not exist on the tower lines.

In using the testing outfit without removing the insulators from the line the oscillator, which weighs about 60 lb. (27 kg.), is raised to the top of the tower so all of the high-potential, high-frequency energy will be available for testing the insulator. If the oscillator were left on the ground, considerable of the energy would be radiated from the long lead reaching from the ground to the top of the tower. The rest of the equipment remains on the truck or wagon, where it is easy to handle and operate.

While sufficient data have not yet been obtained from tests on the tower line shown for complete conclusions, the evidence so far indicates a much smaller percentage of defective units on this line than was obtained on the wood-pole lines. However, even in the very best sections of line the percentage of defective units found is sufficient to show that frequent testing is necessary to prevent interruption of service. As evidence that such precautions are effective as insurance for continuous operation, it may be pointed out that the operating records of the three lines tested show after a year's operation just one case of shutdown due to insulator trouble. That interruption lasted only a few seconds, it being necessary to "kill" the line only long enough for the arc to be broken. The line was immediately put in service again without the damaged string of insulators. They were replaced later, when the line could be cut out without interrupting service.



FIGS. 3 AND 4—TWO METHODS OF TRANSPORTING PORTABLE TEST SET, ONE ON AUTOMOBILE, THE OTHER ON A TRAILER

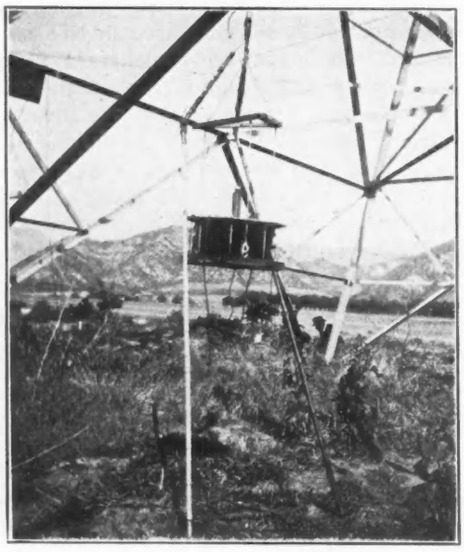
During the time these tests were being conducted

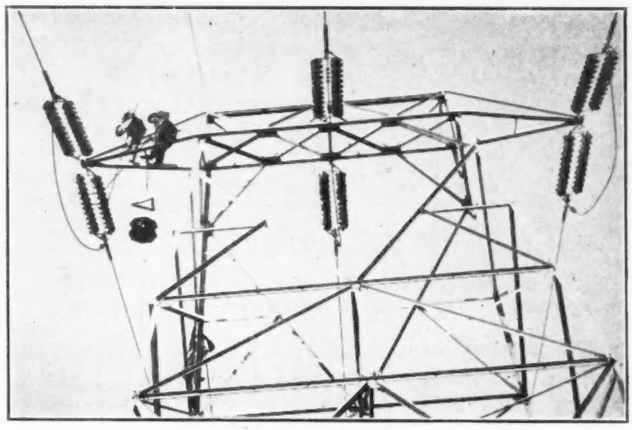
careful observation was made of the location of the defects in the insulators and probable cause of each defect. A careful record was also kept of the conditions under which each insulator had been operating—such as voltage of line, average voltage per unit, kind of string (dead-end or suspension), its position in the string, etc.—and no evidence could be secured to indicate that any of these things had any pronounced effect upon the rate of failure.

As a result of these observations it was concluded that the failures, which were so predominatingly of one type—viz., a crack in the porcelain under the base of the cap—must be due to stresses produced by temperature changes, assisted possibly by moisture absorption in the cement joining the cap and pin. This conclusion was reached because the failures were relatively more numerous in fog belts than in districts where fog does not occur, and also in places like the boundary line between hills and plains where hot winds may sweep up from the valley during the day and cold winds down from the hill canyons at night. For further confirmation of the temperature-change theory tests were made on insulators purchased at the same time as those on the lines but which had been stored in sheds for future use. The results of these tests, which are given in Table III, show a percentage of failures equal to that observed on those parts of the line situated in what might be called locations of favorable climate. This appears to indicate that the failure is due chiefly to mechanical causes, not electrical ones.

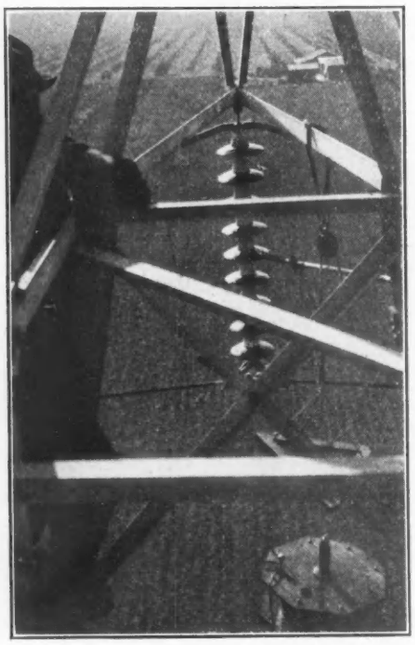
TABLE III—TESTS ON STOCK INSULATORS STORED IN SHEDS

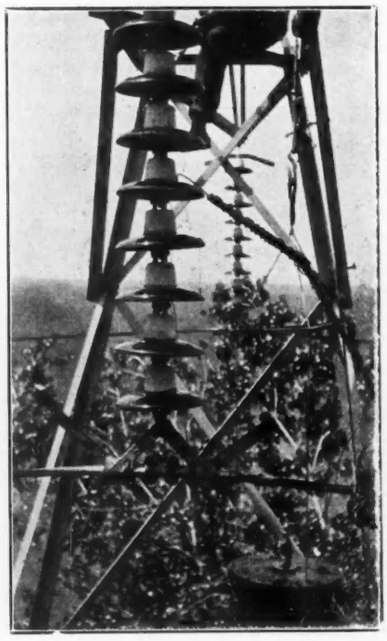
Number tested	493
Number defective	53
Per cent defective	10.7



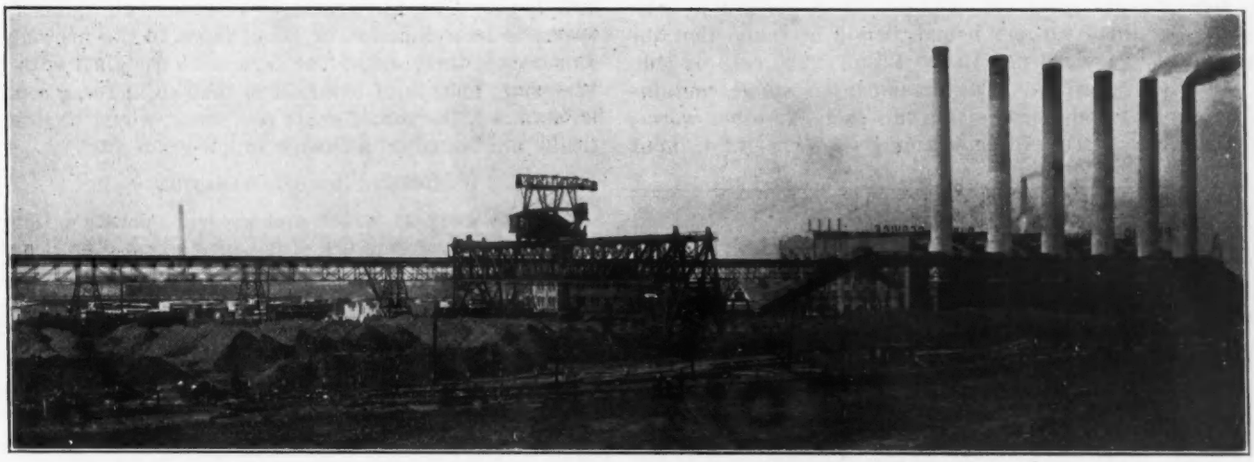


FIGS. 5 AND 7—OSCILLATOR, WITH TEST STICKS ATTACHED, BEING RAISED TO TOP OF TOWER; HIGH-FREQUENCY OSCILLATOR IN USE ON DEAD-END TOWER





FIGS. 6 AND 8—CLOSE VIEWS OF OSCILLATOR IN USE ON SUSPENSION TOWER; ARC-OVER STREAMERS CAN BE SEEN IN THIRD UNIT FROM TOP



Using Low-Grade Fuels with Existing Equipment

Some of the Problems Involved in Burning High-Ash Coals, with Discussions Regarding Effect on Rating of Stoker, Air Requirements, Efficiency of Combustion, Operating Methods and Maintenance

BY R. J. S. PIGOTT

Consulting Engineer, Sanford-Riley Stoker Company

PRESENT high prices of coal of all kinds, and deterioration in quality and calorific value due to shortage of labor for cleaning at the breakers, confront the users of coal with a serious problem. The desire to reduce expenses results in the purchase of lower-grade fuels, but the use of such material brings up the question of whether the stoker will handle it. In this article some of the problems involved in burning high-ash coals will be discussed and the performance of stokers with low-grade and high-grade fuels will be compared.

EFFECT ON RATING OF STOKER

Fuel with a low calorific value has the effect of cutting down the forcing capacity of the fire, since the fact has been established that combustion cannot be carried on satisfactorily above fairly definite rates. As much as 100 lb. of coal has been burned per square foot (488 kg. per sq. m.) of projected grate surface† per hour, but the maintenance of brickwork and stoker parts is high and the ejection of considerable quantities of fine cinder through the boiler into the flues and out of the stack is the inevitable result unless excessively large furnaces are provided. Seventy pounds per square foot (342 kg. per sq. m.) per hour is about the maximum rate that will give good operating conditions over long periods of forcing. A stoker installation should not be designed for regular operation at a higher rate. With 14,500-B.t.u. (3650-cal.) coal, the desirable maximum B.t.u. input per square foot per hour would therefore be 1,015,000 (2,750,000 cal. per sq. m.); for a 10,000-B.t.u. (2520-cal.) coal it would be 700,000 (1,900,000 cal. per sq. m.) or 69 per cent of the high B.t.u. coal input. The maximum boiler-horsepower output would be reduced in the same ratio. To use the low-grade fuel at the same maximum output from the boiler would consequently require about 45 per cent more stoker grate surface for 10,000-B.t.u. (2520-cal.) coal, 16 per cent more for 12,500-B.t.u. (2900-cal.) fuels and 7.5 per cent more for 13,500 B.t.u. (3400-cal.) fuel, as compared with 14,500 B.t.u. (3650-cal.) coal. If the reduction in maximum rating by the use of lower B.t.u. coal is large, it would probably be necessary to install more stokers to meet the steam demand, unless the owners are willing to accept excessively high maintenance and consequent reduction in reliability.†

TABLE I—QUANTITY* OF AIR REQUIRED PER POUND OF FUEL AND COMBUSTIBLE AND PER B. T. U.

	Air/ Pounds Fuel (lb.)	Air/ Pounds Combustible (lb.)	Air/ 10,000 B.t.u. in Fuel (lb.)
North Dakota lignite	5.0	9.2	7.54
Colorado lignite	7.5	9.9	7.53
Illinois bituminous	8.4	10.8	7.66
Ohio bituminous	9.7	11.2	7.63
Pennsylvania bituminous	10.3	11.3	7.50
Pennsylvania semi-bituminous	10.8	12.0	7.65
West Virginia semi-bituminous	11.2	12.1	7.65
Pennsylvania anthracite	9.6	11.9	7.66
California crude oil	14.1	14.2	7.59
Average	....	....	7.60

*Data obtained with the Edge-Moor boiler

AIR REQUIREMENTS

Contrary to the very general belief, very little difference in amount or pressure of blast air is required with various kinds of coal provided the horsepower output is the same. If the air required for coals of various characters is figured by the usual formula $X = \left(\frac{8/3\,C + 8H - O + S}{0.23}\right)$, it will be found that the high B.t.u. coals require more air. But if the quantity of air

†In the figures mentioned above the grate surface is figured as the whole projected area of the stoker, including dump grates. All underfeed stokers supply enough air through the overfeed portion or extension grates to carry on a lively combustion clear to the bridgewall, and if these grates are kept in continuous motion the air has an opportunity to strike all combustible. The method of figuring grate surface as the whole area of the stoker, therefore, seems to be a more nearly rational standard. It is not at present possible to give an absolutely basic unit, since the volume undergoing distillation as well as grate surface has an important bearing on efficiency.

required per pound of combustible is divided in each case by the B.t.u. per pound, it will be found that the quantity required per 10,000 B.t.u. (2520 cal.) is substantially constant. The accompanying table contains examples which demonstrate this fact. In other words, the air required will depend only upon the B.t.u. input

FIG. 1—INTERIOR OF UNDERFEED STOKER, SHOWING HOW FIREBRICK OVER RETORTS HAS BEEN ERODED

to the fire, and therefore upon the boiler-horsepower output and the efficiency only.

As far as rating is concerned, then, the fans will be unaffected by any change in the B.t.u. content of the coal, except as the efficiency is affected. The air required by any boiler at any rating is derived as follows:

Pounds air per 10,000 B.t.u. = 7.60.

At 65 deg. Fahr. 1 lb. air = 13.75 cu. ft.

Theoretical cubic feet of air per minute per 10,000 B.t.u. per hour $= \frac{7.60 \times 13.75}{60} = 1.74.$

Actual cubic feet of air per minute per boiler-horsepower at 100 per cent efficiency, 55 per cent excess air $= \frac{7.60 \times 13.75 \times 3.348 \times 1.55}{60} = 9.02.$

Therefore, the actual quantity of air required per minute for any horsepower output will be

$$Q = \frac{\text{B.-hp.} \times 9}{\text{Efficiency}}$$

For 50 per cent excess air, constant = 8.70.

For 40 per cent excess air, constant = 8.14.

It is very easy to see why the air per 10,000 B.t.u. (2520 cal.) should be constant, when it is considered that the ratio of air required by hydrogen and by carbon is $\frac{34.6}{11.5} = 3$, and the heat developed is $\frac{62,030}{14,540} = 4.27$. The latter ratio is cut down by the presence of oxygen, so that the two ratios move very nearly parallel. It is better to use the higher constant in order to provide ample margin for keeping up capacity during recovery after a period of bad operation. It is a risk to reliability to figure too closely on fan sizes.

From examination of a large number of tests, it has been found that, with the exception of extreme cases, the blast pressure required is very little greater for low-grade than high-grade fuel at the same output and handled in the same manner. The most important cause of variation is the handling of the fire, variation in depth of bed, prevention of heavy clinker formation and holes. The air pressure, like the air quantity, seems to be a function of B.t.u. *input* to the fire only. Apparently then, unless the fans were designed with a very snug margin of overload so that no increase could be obtained, the forced-draft equipment would be practically unaffected by a change to low-grade fuel.

Efficiency of Operation

The efficiency at which stokers will operate is lowered somewhat by the use of low-grade fuel. As far as can be discovered, however, the amount is not very great for reasons which will be discussed under operation and maintenance. When burning coal with a calorific value between 13,500 and 14,500 B.t.u. (3400 and 3650 cal.) there is hardly a detectable difference; lower than 13,500 B.t.u. (3400 cal.) the reduction appears to be about 1 per cent for every 1000 B.t.u. less per pound (556 cal. per kg.).

The reasons for the reduction are: First, the higher ash content carries off a higher amount of combustible entangled with the incombustible refuse, thus increasing the percentage of loss by way of the ashpit. Further, with the higher percentage of incombustible a larger amount of fine ash is carried out through the boiler, tending to foul the heating surface more rapidly and slightly reducing the efficiency in this way. From the principles of underfeed firing, however, it appears improbable that the actual combustion efficiency in the furnace is any poorer than with the high-grade coals.

Operating methods have a considerable effect on the efficiency that can be obtained too. With the high percentages of ash in the low-grade coals and the usual increase in sulphur and pyrites, especially, the tendency to clinker is excessive. If the fires are not properly handled, clinkers may be formed which seal over parts of the fire, causing imperfect distribution of air and unbalanced relations between air and volatile matter, besides cutting down the rate of combustion in those portions of the fire covered by the clinker.

One of the chief factors influencing efficiency is the volume of coal in the fire. It is a known fact that a

FIG. 2—ONE SIDE OF FURNACE, SHOWING BRICKWORK WHICH HAS BEEN FUSED

certain depth of fuel bed is essential in a producer to proper mixing of air, steam and volatile matter for final reduction to a uniform gas. This is also true to a considerable degree in the underfeed stoker. While grate surface has a well-fixed relation to rating, other things being equal, the stoker which has the most vol-

ume of coal undergoing the process of distillation per square foot of projected surface will have the higher combustion rating. Therefore, for boilers which are to be forced to a very high degree it is desirable to provide as much retort capacity as possible so that the largest volume of coal possible will be under distillation all the

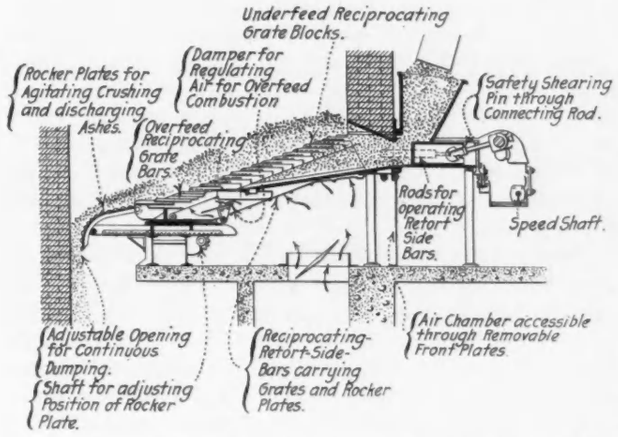

Underfeed Reciprocating Grate Blocks.
Rocker Plates for Agitating Crushing and discharging Ashes.
Damper for Regulating Air for Overfeed Combustion
Safety Shearing Pin through Connecting Rod.
Overfeed Reciprocating Grate Bars.
Rods for operating Retort Side Bars.
Speed Shaft.
Air Chamber accessible through Removable Front Plates.
Adjustable Opening for Continuous Dumping.
Shaft for adjusting Position of Rocker Plate.
Reciprocating Retort-Side-Bars carrying Grates and Rocker Plates.

FIG. 3—FUEL BED KEPT IN MOTION BY MOVING GRATES

time. Certainly the time of distillation is a function of the depth of the retort; consequently the smokelessness of the fire will depend to a considerable degree upon this depth.

For successful burning of very low-grade fuels it is desirable to have a large combustion space. While the underfeed stoker is much better in the mixing of air and volatile matter than the old overfeed, it is still far from perfect. Consequently furnace volume is required for the completion of the mixing and burning of air and volatile matter. Best results are obtained with a furnace volume of about 9 cu. ft. per square foot (3.7 cu. m. per sq. m.) of projected area of the stoker. There are many installations which have not more than half this amount, but the restriction manifests itself in an increase of flue temperature. This is due to delaying the combustion of volatile matter and causing secondary combustion to take place at the top of the first pass. Operators who are employing underfeed stokers with low settings can consequently expect somewhat lower efficiencies with the low-grade coals than those who are more fortunate and have spacious furnaces. Certainly no new installation of Babcock & Wilcox boiler or any similar type of standard boiler should be made in which the bottom of the front header is less than 11 ft. or 12 ft. (3.4 m. to 3.7 m.) from the floor. With Badenhausen or Stirling boilers having very sharply inclined front tubes it is not a difficult matter to obtain generous combustion space.

Another make of underfeed stoker has stationary tuyères and retorts, but uses a moving overfeed section which pushes the clinker upon the adjustable dump grates with a view to continuous dumping. There is no motion of the grates as a whole relative to the furnace walls and bridge walls. A third type of stoker employs motion of the overfeed grates only. The motion of the fire bed is obtained from the plungers and rolling of the fuel by gravity, the inclination of the grates being about 25 deg.

There are two types of dump employed—the steam dump and a roller crusher. The steam dump is simply the application of a steam cylinder to the old hand dump, giving a quick-return effect which is used to knock the clinkers off the bridge wall. The other device is usually applied to heavy-duty stokers, and consists of a deep pocket formed of ribbed cast-iron plates just beyond and below the extension grates. An adjustable swinging dump gate is used in conjunction with a roll crusher very similar to the old Murphy clinker crusher. Probably it is intended to allow the ash to cool and solidify before being brought down to the roll crusher. In the writer's opinion, however, the quicker the ash, hot or cool, is taken away from the cast-iron parts, the better. In accumulation lies the source of trouble.

The company with which the writer is connected has found that trouble from clinkers can be alleviated by keeping the surface of the grate in continuous motion, one way of doing this being to move the retort as a whole. The motion of the individual retorts at intervals which do not coincide causes a shearing action on the clinker between each retort. This may be increased with particularly bad coals by allowing only one-half of the retort to move, thus doubling the number of shearing lines. This continual motion tends to break up the clinker during the earliest stages of formation and acts as a preventive rather than a cure. This is especially noticeable at the side walls, where the adherence of clinker is very much reduced by this motion.

The next step was to carry the shearing action to the bridge wall where the most severe troubles with clinker are apt to occur. This was done through the medium of a rocker dump attached to the retort sides, from which it receives its motion. The result is that huge formations of clinker on the bridge wall do not occur with this device and the cleaning of the fire is not only very much simpler, owing to the fact that all clinker is kept small, but need not be done so frequently. In more than one plant the interval between cleanings has been increased from four or six hours with the old dump to from one to two days.

With a number of the French and English coals in

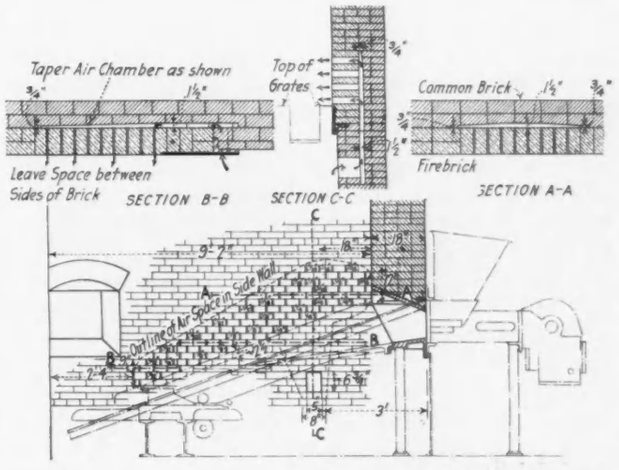


FIG. 4—VENTILATED SIDE-WALL CONSTRUCTION WHICH SOFTENS CLINKERS AND PREVENTS ADHERENCE

use on the European continent it was found that the use of stokers not having a continual motion to break up clinker had to be practically discontinued, as these coals are on an average very much poorer in quality than American coals. It is impossible to deal satisfactorily with the obstinate clinkers formed from high-

ash, high-sulphur coals unless there is continuous disturbance of the fire to prevent the clinkers welding together in large masses. In cases of very bad coals further disturbance of the fire can be obtained by means of ventilated coke breakers placed in the bottoms of the retorts. These coke breakers form a projection over which the fire must pass, producing a shearing line across the furnace which aids the action of the shearing lines produced from front to back of the furnace by the motion of the retort sides.

With the bad coals to be expected now, hand-fired furnaces will likely become such a burden and have such low ratings that they will be out of the question. Almost all of the low-grade coals are characterized by high ash in combination with high percentage of pyritic sulphur. The great objection to this combination of iron and sulphur is that it forms obstinate plastic clinkers which also have the undesirable quality of fluxing the iron of the tuyères or grates very much more readily than ordinary ash. In some cases a chemical action analogous to catalysis seems to take place in which a small portion of the tuyère will get hot enough to melt and the heat will be rapidly propagated to the neighboring parts of the stoker, resulting in a large burned area and complete breakdown. This condition, can occur, however, only if the coal lies practically undisturbed upon the iron.

COMBATING THE CLINKER NUISANCE

Trouble from this source has been successfully avoided by the continual motion of the grates, which keeps all these masses broken up and shifting. The contact of the clinker is therefore not intimate enough to start this melting action. There has been no case reported so far of the failure of stokers from this cause when grate motion is employed. There is no stoker built which will not give considerable trouble with bad coals if improperly handled, but there is certainly very much less risk where the grate is kept in continual motion and the clinkers thus kept down in size and free from intimate contact with the iron.

Generally speaking, the higher the temperature the greater the amount of clinker formed, since it is a function of the fusing point of the ash. Consequently more trouble is to be expected at high ratings than at low ratings. Since with very deep fire beds the temperature within the bed is higher at any rating, it is desirable to reduce the thickness of the fire as far as possible without, on the one hand, injuring the efficiency and, on the other hand, causing too much burning of the iron parts of the stoker because of bringing the intense zone of combustion down closer to the grates.

The maintenance of stokers must necessarily be higher with low-grade coals since in order to meet the conditions of burning the fire must be run thinner. This tends to injure the iron more and there is bound to be more formation of clinker, which in turn tends to fuse the brickwork. If the fire is allowed to remain stationary, the impurities in the fuel will fuse together in large masses which must be broken off by hand barring or by the power dump in those stokers so equipped. Where an attempt is made to dislodge large pieces of adhering clinker whole courses of the face brickwork may be torn out, especially that of the bridge wall. Motion of the grates minimizes the adherence of large masses of clinker, but even then the action of the clinker is to form a fusible flux with the surface of the brickwork which melts and runs down in vitreous masses, gradually eating away the surface of the brick.

Of course, all of the effects mentioned are greatly aggravated if stokers are operated at very high ratings. The desirable condition should therefore be to keep the ratings on the stokers as low as possible. In fact, in many cases it will be found desirable to operate more boilers at somewhat lower rating with the low-grade fuels in order to reduce the average rating. Probably it would not be stating conditions too strongly to say that at least 50 per cent increase in maintenance is to be expected, even with all of the preventive measures noted above, if low-grade fuels are substituted for high-grade coal.

An additional advantage which may be realized by running more boilers with lighter loads is that the stokers can be kept in continual motion, which with slagging or heavy clinkering coal is very desirable. In short, the banking periods should be eliminated as far as possible with low-grade fuels. If banking is absolutely necessary, the stokers should be agitated at intervals of one or two hours in order to break up the large masses of clinker which tend to form during long periods of quiescence. The stoker parts are not likely to suffer seriously unless the operator is so careless as to run the fires very thin, in which case burning of the tuyères will certainly result to some extent.

Naturally, those troubles experienced with brickwork with good coals will be worse with poor coals, especially since the presence of sulphur and high ash tend to form fusible fluxes with the brickwork. It has been generally observed that coal and firebrick from the same district will usually be unsatisfactory when used together.

There has been a limited use of highly refractory and expensive makes of brick, such as bauxite or carborundum, for linings near the fire, with a view to cutting down maintenance. Ventilation of side and bridge walls with air and steam will give as satisfactory results at much less cost and has the additional advantage of assisting combustion and softening clinker formations. The writer's own work at the Dayton Power & Light Company, the Interborough Company and later installations along the same line by the Buffalo General Electric Company have proved that brickwork conditions can be greatly improved by wall ventilation. Admixture of exhaust steam with the blast air for ventilation permits controlling the mixture so as to avoid upsetting CO_2 conditions and has the additional advantage of softening clinker and preventing adherence to the brickwork. This scheme is particularly valuable with stokers having no motion of the grates.

The ventilated side-wall construction shown in Fig. 4 is an ingenious modification of this scheme. This consists chiefly of a chamber formed directly in the wall, the outlets to the fire consisting of spaces between the edges of the firebrick, laid up dry on the vertical faces. The original idea of the writer was to use a wrought-iron pipe header, supplying a number of 1-in. (2.54-cm.) pipe nipples, feeding through the wall. Curiously enough, very little trouble is experienced from the openings "sealing over." Even with great fluxing action, it was found that if an opening occasionally sealed over corrosion of the brickwork commenced, ate through the seal, and protection was re-established.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CHIEF CONSIDERATIONS OF USE IN JOINING CABLES

Splicing Sleeve Should Have Ample Conductivity—Precautions to Be Used with Filling Compounds, and Practices of Chicago Company

A few of the requirements which should be considered in making underground cable joints are as follows: In order to prevent the insulation from being cracked when bending the individual conductors, the distance from the exposed conductors to the lead sheath should be 6 in. or 7 in. (15.2 cm. or 17.8 cm.), depending upon the thickness of the insulation around the conductors.

Since the resistance around the conductors at joints is usually made thicker than in the cable, heat radiation is reduced and the temperature of the joint will be increased thereby. If in addition the copper sleeves have a carrying capacity less than that of the conductor, the temperature of the joint will be still further increased. As all forms of insulation have a critical temperature above which the dielectric loss is so great that the temperature will continue to rise until a burnout occurs, the splicing sleeve should have ample conductivity. The exterior surface edges of splicing sleeves should be carefully finished to prevent excessive dielectric stresses.

So that conductors shall retain fixed positions relative to each other and to the inclosing lead sleeve they should be separated from each other and the sleeve by some form of solid insulation, consisting of wrappings of insulating tape or formed or molded insulation, such as tubes of paper or other solid insulating material. Gages should be used for determining the proper amount of insulation to apply. When mechanically formed insulation is used, care should be taken to see that the parts are so shaped, placed and fastened that all air will be driven out by the filling compound.

Filling compounds should have a dielectric strength which is not considerably reduced at the maximum operating temperature, should be non-hygroscopic, and should not crack in cooling or during cold weather. When being poured they should be sufficiently liquid to flow into all air spaces before becoming chilled. At ordinary temperatures the compound should be of such consistency that it can be readily removed without injuring the original insulation around the conductors. It should have a low coefficient of expansion, shrinkage being allowed for by adding compound after the first "pour" has cooled slightly.

In applying wrappings of tape, the conductors, the splicing sleeve and the insulation around the conductors should be given alternately a generous coating of some thin insulating compound and the tape should be tightly wrapped until the required thickness is obtained as determined by the gage used. If some form of molded insulation is used, it should be held in position temporarily by the form of the insulation or by tying with string or tape. In either case air should be excluded.

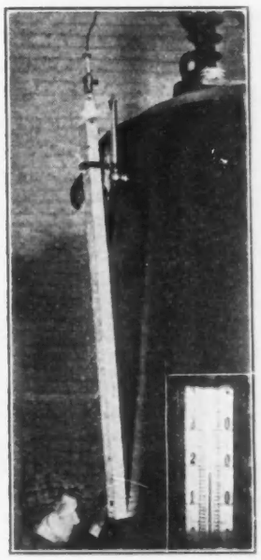
All moisture should be carefully excluded from the joint. It may be necessary to install some temporary shelter so as to prevent drippings from the roof or contact with the adjacent wall of the manhole. If necessary, rubber gloves should be worn by the cable splicer and care taken that no perspiration drops into the joint. If filling compound with a low melting point is used, care should be taken that it does not run back into the cable at the maximum operating temperature.

These points were brought out by D. W. Roper, superintendent of street department, Commonwealth Edison Company, at the last annual meeting of the A. I. E. E.

PERISCOPE FOR READING TRANSFORMER TEMPERATURES

Overcomes Inconvenience of Carrying Stepladder to Each Transformer—Details of Construction Given

In order to read the temperature of the oil as indicated by the thermometers on transformers, the Pacific Power & Light Company in its Walla Walla (Wash.) substation has attached periscopes to each transformer to enable the operator to observe the temperature from the floor. This makes it unnecesary to use step-ladders.



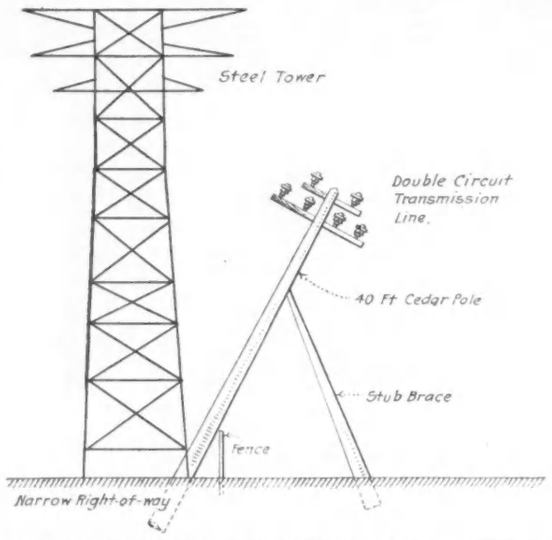
PERISCOPE AND IMAGE OF SCALE

The periscope consists of a square metal tube 4 ft. 8 in. (1.4 m.) long and 2 in. (5 cm.) square. At the ends are placed two mirrors facing each other at an angle of 45 deg. with the sides of the tube. The lower mirror is 1⅞ in. (4.8 cm.) wide and 3 in. (7.6 cm.) long, while the upper one is 1⅞ in. (4.8 cm.) by 3⅜ in. (8.6 cm.) long. The upper mirror is made longer to give a longer view of the thermometer scale. At the top of the periscope and directly in front of the upper mirror is a hole 1¾ in. by 2 in. (4.4 cm. by 5 cm.) while there is a hole 1 in. (2.54 cm.) square cut opposite the lower mirror. Observations of temperature are taken by looking into the small hole at the bottom of the periscope as shown in the illustration, which also shows the thermometer scale as seen through the periscope. The thermometer scale is illuminated by a lamp suspended near it.

ERECTING STEEL TOWERS ON POLE LINE RIGHT-OF-WAY

By Inclining the Wooden Poles so that the Wires Would Clear Towers, New Structures Were Set in Direct Alignment

In reconstructing about 0.5 miles (0.8 km.) of transmission line in which wooden poles were replaced by steel towers, a Middle Western company wished to set the towers in practically the same alignment as that



SOLUTION OF RECONSTRUCTION PROBLEM ON A NARROW RIGHT-OF-WAY

already occupied by the poles. It was at the same time important that service be maintained on the pole line while the new work was going on. Obviously this could not be accomplished if the towers were swung up into the overhead lines. Since the right-of-way at this point was narrow, permission was obtained to set stub poles temporarily on adjoining land. The upper part of the wooden pole line was then leaned over by digging out behind the butts of the poles and pulling them down until they touched the upper ends of supporting braces. The line was operated in this fashion until the work was finished.

LARGE AIR GAP CAUSE OF EXCESSIVE SPEED IN MOTOR

How the Fault Was Found and How It Was Remedied—Method Followed in Making the Various Tests Outlined

BY R. L. HEARVEY

A 35-hp., 500-volt interpole compound motor having a 4-ft. (1.2-m.) friction-saw blade mounted on the armature shaft was used to saw iron beams. During a lightning storm two field coils were burned out and the armature was grounded. To save time the grounded armature coil was cut out and the two field coils were rewound. When reassembled the armature ran 2300 r.p.m. at no load instead of 1900 r.p.m., the increased speed causing the saw blade to wabble badly when sawing. The first test made was to determine if the shunt coils had the proper voltage drop across each and if their polarity was correct. Both were found to be right. The next test was to check the polarity of the compound field coils. This was done by opening the shunt circuit and starting the motor as a series machine. If the armature starts in the same direction as a series motor as it does as a shunt, the field coils are properly connected, as they proved to be in this case. This test requires considerable care as the field will be very weak and speed will reach dangerous proportions in a few seconds.

The above tests showed the voltage drop across the shunt coils to be uniform and the polarity correct for both the shunt and compound windings; hence there could be but one other cause for the high speed at no load—that is, a weak field. As there was about 3/32-in. (2.4-mm.) clearance between the armature and the poles, sheet-iron shims 0.04 in. (1.23 mm.) thick under each pole were tried, which brought the speed down to 2000 r.p.m. This was still too high, so the shims were increased to 0.055 in. (1.78 mm.), which gave a speed of 1900 r.p.m. At this speed the motor has been operating satisfactorily for over a year.

TESTING ARC CIRCUITS FOR GROUNDS AND OPENS

Magneto Method Abandoned in Favor of One Using Lamp in Series with Line and Source of Low-Potential Energy

BY W. R. DAVIS

In the plant of the Springfield Gas & Electric Company, Springfield, Ill., it is the custom to test the arc-lighting circuits for grounds or open circuit every day about an hour before lighting the lamps. These circuits supply the lamps at railroad crossings, and it is very important that they should always be ready for service. A magneto was used for testing until the writer received a severe shock one day when attaching

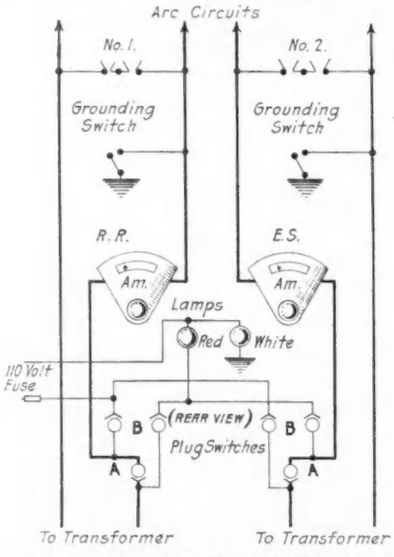


DIAGRAM OF CONNECTIONS FOR TESTING ARC CIRCUITS

the test wires to the circuit. The arc circuits are carried on poles that also carry 2300-volt wires, so there is a chance of their coming in contact with the high-voltage circuit and perhaps just at the time when the test wires are being attached. It was therefore considered advisable to use the method shown by the accompanying diagram.

A and *B* are standard plug switches. When the cir-

cuits are energized switches *B* are open and switches *A* closed. When testing, the transformer oil switch is opened, switches *A* removed and switches *B* closed. Under this condition the arc circuit is energized from a 110-volt circuit. By putting a 5-watt lamp in series with the entire arc circuit, including the secondary winding of the arc transformer, a positive indication that the circuit is closed is obtained if the lamp burns. In series with one side of the 110-volt test circuit and ground is another 5-watt lamp, which lights if the arc circuit is grounded. The 110-volt test circuit is energized by a 50-watt potential transformer. Plugs *B* must always be removed and plugs *A* inserted before closing transformer switch. Before sending a man out on the line to clear trouble the grounding switches are closed and a "hold" card placed on the transformer oil switch to guard against any interference.

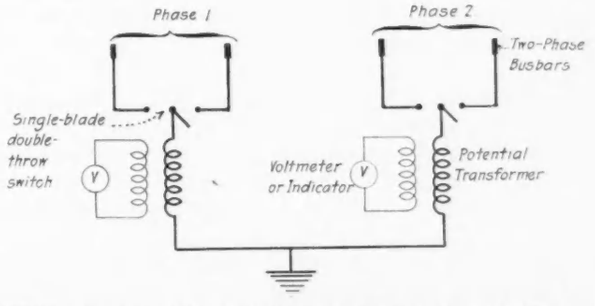
GROUND DETECTOR FOR USE WITH TWO-PHASE SYSTEM

Useful Device Developed by the Pacific Gas & Electric Company Consists of Two Potential Transformers

To detect grounds on its two-phase distribution system, the Pacific Gas & Electric Company, San Francisco, Cal., has developed a detector which consists of two potential transformers. One terminal of each transformer is joined with a single-pole, double-throw switch, while the remaining primary terminals are grounded. The secondaries are connected with the ground indicators. The jaws of one switch are joined with the legs of one phase, while the other switch is similarly connected with the other phase. Switch hooks are employed to operate the switches.

Formerly only one potential transformer was used, and the ungrounded terminal was connected to four busbars by fuse receptacles. However, this arrangement was dangerous as the fuses might "blow" and burn the operator's hands or face, and there was always a possibility of inserting two fuses at the same time in such a manner that a short circuit would occur. Finally there was the possibility of the plugs being unavailable in an emergency.

With the two-transformer arrangement none of these



METHOD OF CONNECTING POTENTIAL TRANSFORMERS TO SERVE AS GROUND DETECTORS

disadvantages exists. While the expense of the double potential transformer and the knife switch is possibly double that of the single potential transformer with fuse plugs, the additional cost is considered as more than offset by having this part of the system absolutely foolproof.

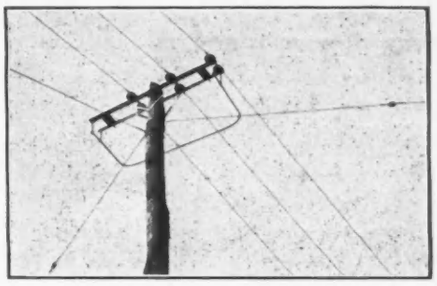
DEVICE FOR GROUNDING BROKEN LINE WIRES

Consists of Iron Pipe with Ground Connection and Is Attached to Pole at Right Angles to Line to Make Contact with Broken Wires

BY N. NESBITT TEAGUE

Augusta-Aiken Railway & Electric Corporation, Augusta, Ga.

A safety device for use at railroad and street crossings or where lines cross wires of other companies is shown herewith, its primary function being to ground broken or extra slack wires before they touch the ground or other wires beneath. It consists of iron pipes, one



METHOD OF INSTALLING PIPE TO GROUND FALLING WIRES

being attached to the double arm on each side of the crossing, so that a wire breaking anywhere in the span will touch the pipe immediately on becoming slack. The pipe is well grounded, and the cost of making and installing this device is very small. Persons or animals touching a broken wire will be safe as long as the wire touches the grounded pipe-work member. This scheme was developed by J. J. Borger, superintendent of the electrical department.

INDUSTRIAL TRUCKS USED TO TEST MOTOR ARMATURES

Energy from Battery of Industrial Electric Truck Used for the Purpose of Testing Armatures of Factory Motors

Efforts to better plant management often make it desirable to test factory motors to ascertain their efficiency in operation. Especially in motors of older types it is necessary to take actual readings to determine the resistance of the armature winding. To obtain this it is necessary to stop the motor and send current through it with the rotor blocked. Then, by knowing the current passing through the armature and the voltage drop across it, the resistance can be calculated.

Practically the only time that this can be done without interruption of service is at the noon hour. But the majority of plants shut off the power supplied to the shop at noon in order to reduce friction losses. Some other form of energy must, therefore, be used in testing. One way to get this energy is to drive an industrial electric truck to the motor, connect leads to its battery and send current through the factory motor's armature. The potential of a battery of this kind is usually about 32 volts. Therefore, the rotor of the factory motor does not have to be blocked and a rheostat is not needed to reduce the voltage as would be necessary when using a higher voltage supply. To insure good results with this low potential, care should be taken that contacts at the commutator are well made.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

ADJUSTING ELECTRIC SERVICE SALES TO WAR-TIME NEEDS

How the Potomac Electric Power Company Has Undertaken to Meet Requirements Without Panicky Economies or Financial Contractions

BY J. C. M'LAUGHLIN

Manager Commercial Department Potomac Electric Power Company, Washington, D. C.

Every business man is by now familiar with the increasing costs in running his business. The government authorities are grappling with the problem. Meanwhile we are obliged to meet the changes from day to day as they confront us. In so far as the business of producing and selling electric energy and service is concerned, we are in a business whose initial financial outlay for installation and maintenance is one of the costliest imaginable. It is even hinted that many parts of our equipment may not be replaceable so long as the war continues.

Increasing costs and shortages of raw material have had a decided influence in reducing our normal surplus, and we believe that our experience is the experience of all other power companies throughout the country. Being part of the public utilities branch of municipalities, local laws prevent us from adjusting our selling prices in proportion to costs of production without sanction of the law.

Our problem, therefore, has been to find some way of increasing our business as much as possible at the least expense with a maximum of efficiency and immediate income.

Prolonged study by the personnel of the commercial department led us to discontinue aggressive seeking of new business by means of the usual campaigns and substitute a plan to intensify present business, thus eliminating the costs of initial extension. This is quite a factor in the amount of savings.

Intensification Better Than Duplication

It has been figured out, in round numbers, that if a customer who has been in the habit of using 10 cents' worth of energy daily can be induced to double the quantity, the profit to the company will naturally be greater than if the original customer were allowed to use the normal amount daily and another customer was obtained to use another 10 cents' worth daily. The totals are the same, it is true, but in the first case one meter, one reading, one bill, one billing operation and one overhead cost percentage would suffice, whereas in the second case all equipment must be duplicated. Duplication means expense.

By this, of course, is not meant that new business must not be accepted or that it is not desirable. On the contrary, new business is always acceptable and is a means of extending our field of activity. But under present abnormal conditions, which affect every individual and every business, efficiency dictates that until better days shall come it is well not to undertake too much.

The question of costs, to begin with, is of less concern to our business than the question of revenue. We know we have to contend with increasing costs. Thus we are put on guard to prepare to continue our business on a paying basis. Our purchasing department can figure out the general average cost of producing a kilowatt-hour. Sales to cover expenses and produce a reasonable income are put up to the commercial department. This department is obliged to make up the proportion of net income lost by increasing costs. If sales parallel the costs within a margin of safety, well and good; if not, we should face the emergency forcing us to ask permission of the Public Utilities Commission to increase our rates—something we should prefer not to do under any circumstances.

Customers Not Thoroughly Informed

We have about 33,000 meters in operation to-day in the District of Columbia and adjacent territory. Perhaps one-third of that number are placed in stores, the rest being found in homes. This shows that 22,000 meters are registering service in homes where, in ninety cases out of a hundred, the energy consumption is not so great as might be desired. In other words, the consumers are not thoroughly informed as to the extent to which electricity could be used by them to do household work and how its increased utilization would mean efficiency.

It is necessary, therefore, to get the householder not to use more light than is required—assuming that fixtures, location, lamp wattage and shades are used judiciously—but to use more energy in other ways, by the use of a fan, a sewing-machine motor, a toaster, an iron, a range, a vacuum cleaner, a washing machine or any other commodity.

The first step is the educative campaign which will cause families who now live in unwired homes to move, as soon as they are ready, not into unwired homes, but into the more modern properties which are rising every day. This would add a few hundred or a few thousand customers in the space of a few years. The project is not very difficult. Wired homes or apartments are the modern residences. Every builder has recognized this fact.

Introducing electricity in unwired homes is the very campaign we have suspended for the time being. We have done so not only because of the excessive cost of raw materials and labor, but also because the campaign can be made efficient and remunerative by diverting it to the channel of development rather than introduction. "Concentrate efforts to-day to develop that which we concentrated our efforts yesterday to introduce," is the slogan. Stress is placed on this point because to us the big problem to-day is not the securing of new con-

sumers but the widest possible use by those who are already using energy.

It is a war-time problem the solving of which will not lose usefulness even after the war is over. Then, when peace is restored and we may hope to stabilize the market and figure out with reasonable certainty what production costs ought to be for a given period, we can go out for new business.

PROBLEM CONCERNS HOMES, NOT BUSINESS HOUSES

In the first place, business houses may be eliminated from our present problem, because all business properties are wired and are being run, it is presupposed, on an efficiency basis, war or no war, with the lamps placed where they will give their best result, with candle-power so measured as to avoid excessive light or waste, or, in the case of power, with motors of the best and most economical quality, their horsepower so regulated as to meet all required needs and no more. But in homes it is different. Even in the home of many a hard-working, efficient business man housekeeping is a drudgery.

The advantage of fostering the use of energy among the actual users makes it possible for us to sell more energy without any extra investment, and this means greater profit. To illustrate, take a family that reduced its bill from $3 to $1.50 by substituting tungsten lamps, but at the end of two or three years consumes $4.50 worth of energy per month because of an iron and a cleaner. This can be increased to $6 by further appliance sales. The number of traceable or untraceable sales which the same family brings about during that time is also worth considering.

RELATION BETWEEN CREDIT AND THE AMOUNT OF SALE

Middle Western Holding Company Fixes Amounts to Be Paid Down, According to Size of Order and Kind of Merchandise

The question of how much to ask as a payment down with any order is not always easy to determine, and many companies for that reason make it a policy to demand a flat percentage down and the remainder in a fixed time at monthly intervals, except in the case of special sales.

The Public Service Company of Northern Illinois, however, bases the amount to be paid down on both the type of merchandise and amount of the order. Its latest order provides that portable lamps, sewing-machine motors, vibrators, hair dryers and ironing machines, where the retail price is $50 and under, shall be sold 10 per cent with the order and the balance divided in twelve equal monthly payments. Where the retail price is over $50, 20 per cent must be paid with the order, the balance to be extended over twelve months. Irons, toasters, grills, curling irons, etc., when priced at retail at $10 and under, may be sold at $1 with order and $1 per month. If the price is more than $10, 20 per cent must be paid down and the balance split in twelve monthly payments.

Power motors may be sold 25 per cent with the order, balance in twelve equal monthly payments; "Federal" washers, one-twelfth with the order, balance in twelve equal monthly payments; Federal vacuum cleaners, 10 per cent with the order, balance in twelve equal monthly payments; electric fans, cash, thirty days.

Five per cent discount for cash in full may be given within thirty days from the date of order on each appliance which retails for $10 or over. Before goods are delivered credit must be approved by the credit department.

COLLECTING BY MAIL AND METHODS EMPLOYED

While Settlement of the Account Is Primarily Desired, Means Must Be Taken to Leave a Friendly Impression Upon the Debtor

When accounts are collected by mail the utility stands to lose or gain friends with almost every letter, according to the way it is expressed. It is with a realization of this fact in mind that so many lighting companies are paying more and more attention to the methods of letter writing which they employ in their collection department.

Form letters are almost universally used now to bring to the customer's attention the nature and amount of his delinquency. Where form letters, however, do not apply and personal letters therefore must be sent, a situation calling for the most diplomatic procedure presents itself.

Before a recent meeting of the employees of the enlarged Southern California Edison Company, Samuel Haver, Jr., credit manager of the company, delivered a paper on this topic, from which the following is quoted:

No matter how well a public service company may be organized nor how much care may be taken in selecting and training its employees, there is always room for improvement in each point of contact with the public whom it serves.

One of the most important points of contact is the written or printed communication, particularly those in regard to consumers' accounts. In sending out a collection form or letter the first consideration is, of course, to send one which will get the money; but another, which this company considers no less important, is to send one which will, if possible, leave a pleasant, friendly impression with the person we are writing to.

Successful collecting by mail is dependent on two things—care and skill in wording each individual communication to the debtor; promptness and regularity in sending and following up correspondence. Correspondence is usually sent out without sufficient thought or by some one inexperienced in the work. Too frequently such letters are in effect a reprimand to the debtor for not having paid, instead of a suggestion of the reasons why he should pay. Quite often letters are sent out at the convenience of the writer, instead of being sent at a time which has been carefully chosen in a well-thought-out collection scheme.

The experience of men who have given this subject much thought shows that a simply worded, courteous letter, putting the facts up to the debtor in a direct man-to-man fashion, will produce the best results. In wording a collection letter keep first in mind the old adage, "You can catch more flies with molasses than with vinegar." Try to figure out the kind of a man your debtor is and then place yourself in his position. Keep the pronoun "I" subservient to the pronoun "you." If a threat must necessarily be made, do not emphasize it too strongly, but try to bring out the reasons why the debtor should avoid the action threatened. Observe carefully the general rules of correspondence. In writing to a business man use as short and concise a letter as possible. In writing to a farmer, and especially to a woman, a longer letter, explaining the situation more fully, will be permissible. In writing to persons of

limited education use short words and explain your thoughts in a simple way. Use short sentences, not too involved. Use short paragraphs, with the most important arguments in the first and last paragraphs. Avoid hackneyed phrases, such as "we beg to acknowledge," "your kind favor," "thanking you in advance," "we beg to remain," etc.

The most difficult accounts a utility has to handle are closing bills against people who can no longer be reached by a personal call. Discussing a plan for handling such accounts, I want to emphasize the importance of collecting all closing bills, if possible, at the time the closing reading is taken. A little trouble spent in getting our money at this most opportune time will save much work and postage later on. Closing-bill collectors should be thoroughly instructed and schooled in this important duty.

If the bill cannot be collected with the closing reading, we must depend upon the results of future calls or resort to an effort to collect by mail. To assist in caring for the conditions arising from such accounts most companies have adopted standard form notices. These afford a basis on which to start correspondence with the debtor. They may in themselves be sufficient to bring in the money, but should only be considered as a means of getting in touch with him. It must be remembered that as soon as a reply is received in response to a form letter the efficacy of any subsequent form is lost, and the subject then becomes one of special correspondence until the account has been collected. When a consumer replies to one of our notices, his reply, no matter what he says, is the collector's golden opportunity. In the majority of cases collection can be made if the case is properly handled from that point on. Even if his reply is a well-worded tirade against corporations and a general denial of his debt, he has acknowledged something in answering the letter and afforded a basis for further correspondence, which, if properly handled, will result in payment of his account or afford us an opportunity of making a friend, if, as in rare cases, it is found that the account is not properly chargeable to him.

To accomplish this, it is highly important that one person be placed in charge of all collection correspondence and that he have sufficient time to take care of this duty regularly each day; that a complete record be kept of all correspondence sent out and the dates thereof and of the results of all personal calls by collectors; that any communication from the debtor be recorded immediately; that all the facts contained in such a record be in mind whenever a letter is dictated; that every possible argument be brought forth to make him pay. For instance, if a debtor has written in that the bill is too large or that some one else owes it, it is useless to write him again if you are going to ignore the claim which he has set up. His contentions must be answered and additional arguments put before him to show why he personally owes the account.

I have said before that our correspondence is never considered closed until we have got the money and, if possible, left the consumer in a friendly frame of mind. We are not satisfied with getting the money and leaving the debtor with a grudge against the company, feeling that he has been obliged to pay a bill which he does not owe or that he has been overcharged. In many instances we have spent as much time and postage in straightening out our relations with the debtor, after the account has been paid, as we did in getting him to send in his remittance. To illustrate this, I will read the correspondence we had with one of our consumers who had moved away leaving an unsettled bill:

"VENICE, CAL., Oct. 9, 1916.

"S. C. Haver, Jr., Credit Agent,
"Southern California Edison Company,

"Dear Sir—In re yours of the 7th inst. Beg to state that the bill would have been paid many months ago if the man I spoke to at the time I moved (at your office) hadn't been quite so officious. At the time that I moved I really couldn't spare the amount of the bill. I will take care of same within a few days. Yours truly, JOHN DOE."

"LOS ANGELES, Oct. 14, 1916.

"Mr. John Doe, 2214 Walnut Avenue, Venice, Cal.

"Dear Sir—Referring to your letter of Oct. 9 in regard to bill of $1.21 for service at 2226 Fifth Avenue, Los Angeles. I am very sorry you feel that you were not properly treated in our office at the time you moved from Fifth Avenue, as our employees are all instructed to observe the greatest possible courtesy in caring for the wants of our customers. Will you please accept our sincerest apology, and I may safely say that you will not have another such experience in any of our offices. In regard to the amount which you owe, I hope you will find it convenient to send me a remittance on or before the 20th of this month. Yours truly, CREDIT AGENT."

"VENICE, CAL., Oct. 16, 1916.

"Mr. S. C. Haver, Jr., Credit Agent,
"Southern California Edison Company.

"Dear Sir—Your letter of the 14th very much appreciated. I am very sorry for my own actions in this matter; it was too small a thing to warrant my going as far as I did. Inclosed please find check for $1.21. Yours in appreciation, JOHN DOE."

"LOS ANGELES, Oct. 23, 1916.

"Mr. John Doe, 2214 Walnut Avenue, Venice, Cal.

"Dear Sir—We acknowledge with thanks receipt of your check in the amount of $1.21 to cover closing bill for service at 2226 Fifth Avenue, Los Angeles, and inclose herewith receipt to cover. We regret any inconvenience which this matter may have caused you, but such instances have at least one advantage—namely, that of putting a large corporation such as ours in closer touch with at least one more of our consumers. We are in business in many cities in southern California, and it is always our desire to maintain friendly and frank business relations with every one. I sincerely hope that you will continue to favor us with your patronage, wherever you may be in need of electricity for lighting or power service, and assure you of our desire to render you the best possible service at all times. Yours truly, CREDIT AGENT."

SOME NEW USES FOR HOUSEHOLD DEVICES

Fans and Vacuum Cleaners Have Been Put to Novel Service in Farming Communities of the Northwest

There are new uses being found for electrical devices almost every day, some good and some bad. The following ingenious use of fans and vacuum cleaners on farms in the territory of the Pacific Power & Light Company may be of value to other companies.

Electric fans have been put to a somewhat novel but entirely practical use at the Congdon Orchards, near North Yakima, Wash. The Congdon Orchards Company has a very fine herd of Aberdeen-Angus prize cattle, which were very much worried during the hot weather by flies and gnats. Four 16-in. (40.6-cm.) fans were installed in their quarters with very satisfactory results.

In the Prosser district there has been found a new use for the vacuum cleaner, which it is expected will open up a new field of work and give the company a chance to place several of these machines on the market. The new idea is to use the vacuum cleaner with the blower attachment to drive the bees out of the supers during the honey flow instead of using the old method of smoking them out. The smoke often discolors the honey and in some cases even flavors it. There are a few bee growers in this locality whom the company is going to have try out this method, and if successful the company will advertise the fact. The idea, it is believed, can be used in several localities where the bee industry is followed, and its success would soon lead to a general adoption of the practice.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

PRODUCTION OF SYNTHETIC NITRATES BY ELECTRICITY

Importance of Contact of Air with Electric Arc, Advisability of Preheating the Air, and Other Considerations of Weight

AN INTERESTING paper was presented recently before the Society of Chemical Industry by E. Kilburn Scott (abstracted in July 27, 1917, issue of the London *Electrician*), in which the author discussed the value of certain furnace details in the production of synthetic nitrates, the advantages of the magnetic and air-blow systems, considerations in starting furnaces, the advantages of preheating the air and cooling the nitric oxide as soon as it leaves the furnaces, and other considerations.

When fixing atmospheric nitrogen in an electric furnace, the reaction depends chiefly on the contact of air with the electric arc; therefore the furnace design which permits the largest amount of air to come under the action of the arc is obviously the best. In some types of furnaces the arc alternately fills the top and bottom half, but never both simultaneously, and as air flows into the reaction chamber through all entrances it follows that only one-half of it can be on the side where the arc is at any moment.

With three-phase furnaces, however, the three electrodes are arranged with intervening firebricks so that together they entirely inclose a six-sided conical space. Air entering the bottom expands and fills the cone before passing out by the only exit, at the top. The currents passing between the electrodes interact in much the same manner as they do in a three-phase motor, producing an arc flame which rotates rapidly in accordance with the periodicity of the supply, which, for example, may be fifty times a second. Since the air takes longer than one-fiftieth of a second to pass up through the reaction chamber, every particle must come in contact with the rapidly revolving sheet of flame.

For the proper working of nitrogen fixation furnaces it is essential to blow the arcs into the flames, and this can be done by magnetic field, as in the Birkeland-Eyde furnace, which has a stable magnetic field, or in the Moscicski furnace, which has a rotating magnetic field. On the other hand, it can be done merely by the air flowing through the furnace, as in the Schonherr, Pauling or Kilburn Scott types. One objection to the magnetic blow is that direct current is required to excite the magnets in addition to the alternating current required for the arc.

For a given power or output the trouble of operating electric furnaces may be said to vary with the number of electrodes, as does also the energy lost in the furnace. The material of which the electrodes are made has an important bearing on the yield. For example, the electrodes of the Birkeland-Eyde furnace consist of a special alloy, which has been found by experience to be beneficial. The modified Pauling furnaces have electrodes made of aluminum alloy which are said to have a catalytic action favorable to the yield.

The author has found that it is advisable to maintain the pilot sparks at all times, because their presence improves the yield and tends toward continuity of operation. Interruptions cause surges and other electrical phenomena which are liable to cause trouble. The three-phase furnace has a special advantage in this respect because the arcs assist in maintaining each other.

Preheating the air not only economizes heat and raises the temperature of the furnace, but it also enables the air to enter the furnace dry and assists ionization. A temperature of 250 deg. C. has been found advantageous for furnaces producing synthetic nitrate. The preheat may be obtained from gases leaving the furnace, one large efficient preheater being recommended for several furnaces.

The chemical reaction involved in producing synthetic nitrates being reversible, it is important to chill nitric-oxide gas quickly. With single-phase furnaces this can only be effected by blowing excess air through the furnace, whereas in some other types of furnaces it can be done by having a boiler mounted directly over the furnace to form a roof, the boiler being connected to earth and serving as the neutral plate for the arc flame. No trouble from corrosion need be expected as nitric oxide does not attack metal. Tests have shown that about 10 per cent of the total energy put into the furnace can be regained in the form of low-pressure steam when a boiler is mounted over the furnace.

The yield which can be expected from single-phase furnaces, the author points out, is 50 to 60 grams of pure nitric acid per kilowatt-hour, or half a ton (0.453 t.) of pure acid per kilowatt-year. From investigations conducted with one type of three-phase furnace it appears that a yield 50 per cent greater than the value given for single-phase furnaces can be obtained.

Generators, Motors and Transformers

Design of Electromagnetic Machines. — STANLEY PARKER SMITH.—Second section of a series, this installment dealing with alternating-current generators. The subject is being handled under the heads "theory," "design of low-speed alternator" and "design of turbo-generators." In the section on theory the following subjects are discussed: Operation of synchronous machines, armature windings for three-phase machines, emf., mmf. and inductance of three-phase windings, conversion of energy, and effect of number of phases on the output.—London *Electrician*, July 27, 1917.

Synchronous Motor Operation.—RALPH KELLY.—By means of simple fundamental principles the following questions are explained: What limits the pull-out torque of a synchronous motor, and what can be done to in-

crease that torque? Why does a synchronous motor carrying normal load pull out of step when the line voltage drops appreciably? Why does overexciting a synchronous motor make it possible for that motor to carry a larger overload, and why is the reverse true when the motor is underexcited? Why is it that a synchronous condenser built only for leading power-factor operation can carry but a small part of its rating when operated at zero per cent lagging power factor, and why does a condenser designed for normal rating, both zero per cent leading and lagging power factor, cost so much more than a standard condenser? What is the explanation of "rotor shift"?—*Electric Journal*, August, 1917.

Essentials of Transformer Practice.—E. G. REED.—Methods of calculating the copper losses in transformers are given and typical examples are solved. Among the subjects discussed are the relation between current density and the copper loss per pound and the eddy-current loss in conductors of rectangular cross-section.—*Electric Journal*, August, 1917.

Lamps and Lighting

Floodlighting for Protection.—J. L. STAIR, K. W. MACKALL and SAMUEL G. HIBBEN.—To secure the best results, the same fundamental principles that make installations successful for other purposes must be applied to protective illumination. First, the light must be directed onto the object to be seen and away from the observer; in other words, onto the hypothetical vandal and the factory surroundings, not the factory building nor the guards. Second, glare should both be avoided and be made useful. It is almost impossible to see beyond a bright light, as every automobilist can testify. The guard should not be subjected to any such handicap, but the marauder should. The fact that glare is extremely objectionable in ordinary lighting installations can be made use of as one of the valuable features of a protective installation. Third, the lighting must be adequate for the purpose, but for commercial reasons must not greatly exceed the minimum permissible value. It should be as uniform as possible. The lights must be inexpensive to install and operate. The field of floodlighting is, primarily, in that class of installations where other units are impracticable, usually because of the difficulty or undesirability of running wires and installing lighting units at the locations where the illumination is wanted. These requirements are amplified in the articles by the above-mentioned authors. Methods of determining the type and rating of lamps to use, the total wattage to employ, the method of installing the lamps, etc., are given.—*Electric Journal*, August, 1917.

Generation, Transmission and Distribution

Condenser Tube Corrosion.—WILLIAM RAMSAY.—Account of some observations and experiments. The author refers to dezincification of condenser tubes, saying that it is a normal process which so long as it remains superficial, as with 70:30 brass, may even be protective. One of the commonest and perhaps most serious forms of corrosion is that which leaves the tube scored with more or less continuous and parallel lines, which eventually cause the tube to split. Tubes drawn from castings having sand cores are much more liable to have laminations that will eventually open up and corrode than those drawn from castings in which the bore is drilled or pierced. Foreign particles which can form galvanic couples with the brass may start corrosion, too, especially along the bottoms of the tubes. Gases adhering to the tubes around the water inlet end and crushing or bruising the tubes with ferrules are also frequent causes of corrosion. Annealing tubes to reduce all hard brass to the soft variety will prevent corrosion due to the contact of these different potential materials. The higher the percentage of zinc in brass the sooner it will corrode. Air, CO_2, ammonia and sewage in condensing water will also hasten the action. Use of cupro-nickel, or even iron or steel tubes, will eliminate corrosion troubles considerably.—London *Engineering*, July 13, 1917.

The Primary Volatile Products of the Carbonization of Coal.—GUY B. TAYLOR and HORACE C. PORTER.—This report is a continuation of the work described in Bureau of Mines Bulletin No. 1 on the character of the volatile matter of coal. The experimental methods have been refined and more precise results obtained. The results presented are more or less of a fundamental character, a study of basic phenomena in carbonization, rather than of the ultimate results of these phenomena as a whole.—*Technical Paper* 140, *Bureau of Mines*, Washington, D. C.

Transmission Line Design.—F. K. KIRSTEN.—This paper contains a complete mathematical analysis of the forces which determine the location in space of a cable suspended from points of equal elevation, and gives the designer and constructing engineer of a transmission line some useful working formulas based on this analysis. Section A of the paper covers the derivation of the catenary formulas and contains a chart from which any catenary problem may be quickly and accurately solved. Section B contains an analysis of the influences of changes in temperature and cable load, resulting in formulas by the aid of which the magnitude of these influences in regard to changes in position of the cable and changes in stresses at any point of the cable may be accurately computed. The formulas derived make it possible to plot a temperature-tension stringing chart to be used by the constructing engineer when stringing the cable at various temperatures. Section C is an investigation of the economic features involved in the proper design of the cable supports. A working formula is derived enabling the designer to determine the most economical span and corresponding height of tower. Solutions of typical design problems are given in each section of the paper demonstrating the use and manipulation of all formulas derived.—*Proceedings A. I. E. E.*, August, 1917.

The Tasmanian Great Lake Hydroelectric Power Scheme.—This article briefly describes the history of this development and the general layout of the system. A new generating unit, consisting of an 8000-hp. Boving-Pelton wheel turbine provided with two jets operating on a single wheel and coupled to a 7000-kva., three-phase generator, is to be installed. A new substation is to be erected to supply energy for the manufacture of calcium carbide as well as for the treatment of zinc ores.—London *Engineering*, July 27, 1917.

Electrophysics and Magnetism

Oscillatory Spark Discharges Between Unlike Metals.—D. L. RICH.—Results of an investigation to determine whether or not the material of the electrodes has

any influence on the initiation of a discharge. The conclusions are based on photographs of oscillatory spark discharges between electrodes of copper, iron, zinc and bismuth with alternating and intermittent direct currents. An interpretation of the relative number of spark trains per half-cycle, the relative number of individual oscillation sparks per train and the relative number of trains containing odd numbers and even numbers of individual sparks is given, with reasons for such interpretation. When the electrodes were alike symmetrical discharges were always found. When the electrodes were of two unlike metals decided rectification effects were always produced, being very pronounced when copper was one of the electrodes and most prominent when iron was the other electrode. In other words, the material of the electrodes is not a negligible factor in the initiation of a spark discharge. If the discharge is electronic, the electrons are emitted from iron more easily than from bismuth or zinc, and much more easily than from copper; they are emitted from bismuth more easily than from zinc or copper, and from zinc more easily than from copper. Arranged in a rectification series, these metals stand Fe, Bi, Zn, Cu. The rectification effects seemed marked and consistent throughout.—*Phys. Review*, August, 1917.

Comparative Studies of Magnetic Phenomena.—S. R. WILLIAMS.—This paper confirms the viewpoint that primarily the Wiedemann effect is a special case of the Joule, but that one condition prevails in the former which does not in the latter, viz., there is a constantly changing direction of the resultant field imposed. This condition gives rise to several variants already noted. There has been offered in this paper an explanation why the maximum twist in steel for the Wiedemann effect comes at lower field strengths than does the maximum elongation in the Joule effect. The importance of considering the effects of auxiliary fields upon the magnetostrictive effects has been brought out. In the case of iron, the earth's field as an auxiliary field has very little influence on the magnetostrictive effects as compared with those in nickel. A possible explanation of why the magnetostrictive effects vary in different substances has been presented.—*Phys. Review*, August, 1917.

Units, Measurements and Instruments

Standard Samples for Thermometric Fixed Points.—In a circular on this topic the Bureau of Standards announces that it is prepared to distribute samples of pure tin, zinc, aluminum and copper for use in testing pyrometers used in measuring high temperatures. These metals melt at definite temperatures, and by using the pyrometer to observe the temperature at which the metal melts it is possible to decide whether the pyrometer reads correctly.—*Bureau of Standards Circular No.* 66.

A Study of the Current Transformers with Particular Reference to Iron Loss.—P. G. AGNEW.—The following summary was made by the author from the work carried out: 1. While the ratio of transformation of current transformers usually decreases with increasing current, it may increase in individual cases, or even pass through a maximum. 2. The ratio and the phase-angle performance may be accurately computed from the magnetic data of the core. 3. In general the slope of the ratio curve may be qualitatively predicted from the value of the Steinmetz exponent if the latter be assumed to be constant. But the iron losses, particularly at the low flux densities used, depart too widely from such a simple law for accurate work. 4. The slope of the ratio curve may be accurately computed from the slope of the curve obtained by plotting the core loss against the flux on logarithmic co-ordinate paper. 5. It is proposed that this logarithmic slope or logarithmic derivative shall be called the ratio of variation. It is much more useful than the actual exponent. 6. The methods now in use for determining the "exponent" fail to give a true exponent that will satisfy the equation $W = KB^z$, unless z is a constant. The quantity actually determined by these methods is the ratio of variation. 7. The wave form of the secondary of a current transformer may be considered to be the same as that of the primary current for even the most precise measurements, as the distortion within the transformer is entirely negligible. 8. While the effect of variations in wave form on ratio and phase angle may be detected by accurate measurements, it is too small to be of practical importance, being of the same order of magnitude as the effect of small changes in frequency. 9. The null methods used for accurate determinations of ratio and phase angle all give the theoretically correct results, well within the experimental error, so that the accuracy attainable is decidedly greater than is required in practice.—*Bulletin of Bureau of Standards*, Washington, D. C.

Telegraphy, Telephony and Signals

Laying Largest Duplex Submarine Telephone Cable in World.—H. M. BENHAM.—The methods used in laying 28,248 ft. (8610.6 m.) of double-armored cable containing seventy-four pairs of No. 16 wire and twelve pairs of No. 22 wires from Keansburg, N. J., to Annadale, Staten Island, were described in this paper. Loading pots were inserted at five points, the splices being tested for water tightness by dry air pumped into the sleeves before filling with paraffine. The locations of the pots are indicated by spar buoys.—*Telephone Review*, August, 1917.

Miscellaneous

Electric Discharge and Crop Production.—Includes a résumé of history and growth of this application with descriptions of early and late types of apparatus designed for use in connection with it.—London *Engineering*, July 27, 1917.

The Metrical System in China.—Apparently authentic news represents China as about to adopt the metrical system of weights and measures. On Feb. 15, according to the report, the stores of Pekin adopted new measurements based on the metrical system. These measurements have been popularized by the Chinese Chamber of Commerce, acting under the instructions of the Minister of Agriculture and Commerce. Just how closely they correspond to the European system has not yet been clearly established.—*L'Industrie Elec.*, July 25, 1917.

Permissible Explosives Tested Prior to Jan. 1, 1917.—SPENCER P. HOWELL.—This bulletin gives the brand names of all explosives now considered as permissible explosives that were tested by the Bureau of Mines prior to Jan. 1, 1917. A definition of permissible explosives is also given.—*Technical Paper* 169, *Bureau of Mines*, Washington, D. C.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

MUNITIONS CONTRACTS FOR WAGNER ELECTRIC COMPANY

Subsidiary Corporation Formed in Connection with Other Interests as a Part of the New Activities

Following a report published in the daily newspapers that large munitions contracts, aggregating a total of $9,000,000, had been awarded to the Wagner Electric Manufacturing Company, St. Louis, the ELECTRICAL WORLD telegraphed to W. A. Layman, president of that company, asking for a statement of the facts.

Mr. Layman telegraphed in reply that the facts as reported were substantially correct. The guns will be made in association with the Root & Van Dervoort Engineering Company, East Moline, Ill., in a special plant being erected there by a new subsidiary corporation called the R. & V. Wagner Ordnance Company. The gun contract is for machining 4-in. (10.16-cm.) naval gun forgings supplied by the government and includes deck mounts.

NEW YORK SUBWAY OPERATION STOPPED BY COAL SHORTAGE

Public Service Commission Orders Interborough Company to Maintain Reserve of 5000 Tons at One Plant

New York City had a shock on the afternoon of Aug. 25, when the Interborough Rapid Transit Company subway suspended operation for several hours on account of lack of coal for its boilers. As it was Saturday, great numbers of people were inconvenienced, and an investigation was begun by the Public Service Commission, First District, on Aug. 27.

The investigation showed that the Interborough company had contracts with the Consolidation Coal Company and with the Berwind-White Coal Company, the president of which, E. J. Berwind, is a director of the Transit company. It was testified that a miscalculation of the amount of coal on hand on the evening of Aug. 24 had been made by the force at the West Fifty-ninth Street power house.

The contract price for coal paid to the Berwind-White company by the Interborough company, $3.23 per ton, has been increased 40 cents on account of increase in labor cost, making a total of $3.63. It was testified that the New York Edison Company is paying the same company $5.25.

During the hearing a number of references were made to the subject of interconnection with the New York Edison Company generating plants and the possibility of such action on a large scale as a further precaution against more difficulty.

The commission announced that it would issue an order requiring the Interborough company to keep on hand at all times at its Fifty-ninth Street plant a reserve supply of at least 5000 tons (4500 t.). When cut into for daily consumption or in an emergency it shall not be lower for more than forty-eight hours. Notice shall be given to the commission whenever the reserve is lowered.

William L. Ransom, chief counsel of the commission, in a public statement, placed the blame upon Mr. Berwind, and declared that there would not have been a shortage if the company of which he is president had furnished the coal called for instead of selling it elsewhere at a higher price than the Interborough contract named.

ELECTRICITY TO MARK AERIAL TRIAL ROUTES

Companies in the Central West Responding to Call for Energy to Guide Student Aviators in Their Flights

Electrical companies in the Middle West and city and town councils are offering enthusiastically to provide the "lighthouses" necessary to mark the aerial routes between Dayton, Ohio, and Indianapolis, Ind., and other cities to be used by the aviation corps of the United States Army in training students for this service.

Carl G. Fisher, chairman of the airplane mapping committee of the national advisory committee on aeronautics, has announced that already word has been received from many towns along the proposed airplane-training route that the authorities and patriotic electric companies would be glad to provide the lighting facilities needed. Searchlights will be turned upward each night to guide flyers on their way during the training period in making night flights.

Large searchlights will be placed in Indianapolis, either on the Soldiers and Sailors' Monument or the Statehouse.

Thomas A. Wynne, Indianapolis Light & Heat Company, has informed Mr. Fisher that his company will provide energy to operate the lamps in Indianapolis free of charge to the government. It is not yet determined whether an appropriation will be asked from the Indianapolis City Council to provide the lamps. The Indianapolis Motor Speedway, which has been turned over by Mr. Fisher to the government for use as a landing place for aviators, also will be equipped with lights.

Mr. Fisher announced that "Dayton will be equipped with the most powerful set of searchlights that can be procured in the United States."

Fort Wayne and Ladoga commercial clubs are ready to supply lights for the committee. T. E. Meyers and Wallace Lee, Indianapolis, are members of a committee which will travel over the route in Indiana to boost the plan of providing the lights as soon as possible.

COAL PRICE-FIXING ORDER AFFECTS INDIANA RATE CASES

Hearings Before Public Service Commission on Surcharge Petition Suspended by the President's Action

The coal price-fixing order of President Wilson has resulted in temporary disarrangement of the plans of Indiana electric companies to press claims for authority to make surcharges on account of extraordinary war costs. However, the developments of the next few weeks in the coal situation will be watched closely by utility managers, and at first sign that prices of last winter and spring are to be in effect during the approaching season petitions for relief will be pressed again before the Indiana Public Service Commission. That appears to be the consensus of opinion in Indianapolis, although the hearing before the commission last week came to a sudden close when the President's order was made public.

Many companies dropped from the list of those participating in the first petition for surcharge filed by the Indiana Electric Light Association. Subsequently companies filed individual petitions. Gradually a number of these companies decided not to press their cases, so that, when the President's order was promulgated, only those cases which the commission had heard, as reported in last week's issue of the ELECTRICAL WORLD, or which are mentioned in the present article, were before the commission.

It seems to be the consensus of opinion in Indianapolis that if the national administration succeeds in lowering coal prices to a normal level again, about the only relief granted by the commission will be in the cases of the Indianapolis Light & Heat Company and the Merchants' Heat & Light Company. Whether the commission has in mind to give these companies relief is, of course, not known. Competitive conditions in Indianapolis have done much to raise operating cost to a high point with these companies, and the former low rates fixed by the old commission, it is complained, have not yielded what is considered an adequate return. Heavily increased taxes also have been added to these companies.

At the last hearing by the commission last week the Wabash Valley Electric Company announced the withdrawal of its petition for a surcharge. Mark E. Webekerer, Clinton, attorney for the company, said that the withdrawal was due to President Wilson's announced coal prices. He said that the government scale would result in a reduction of 80 cents per ton for coal used by his company.

E. J. Condon, Angola, president Indiana Utilities Company, asked for the postponement of the hearing on the petition of that company for a surcharge. The government's action influenced him to take this action.

The Martinsville Gas & Electric Company, which was to have had a hearing, had no representative present, and its case was postponed. Homer L. McGinnis, city attorney, moved for the dismissal of the petition, but the commission decided not to act until the company is heard. The petitions of the following companies have been heard: Browne-Mills Electric Company, North Manchester; Madison Light & Railway Company, Oakland City Light & Power Company, Batesville Electric Light & Power Company, Rockport Waterworks Company, Owensville Light Company and Boonville Electric Light & Power Company.

E. I. Lewis, chairman of the commission, and Edwin Corr conducted the hearings.

Kenneth Weyerbacher, Boonville Electric Light & Power Company, said that he anticipated a 50 per cent increase in the price of coal and 25 per cent increase in labor cost during the next year, and that his company wished authority to add a surcharge of 30 per cent. As Boonville is in the midst of the Indiana bituminous coal fields, Mr. Lewis questioned Mr. Weyerbacher at some length. It was shown that the Boonville company had been buying mine-run coal for $1 a ton delivered, but that the price had been raised to $1.50 a ton. Mr. Weyerbacher said that he bought coal from a small mine which was not as well equipped as larger mines that loaded coal directly on railway cars. Coal that was loaded on cars from larger mines brought $2 to $2.50 at the mine, he testified.

Mr. Weyerbacher said that, although his plant was close to the mines, he figured that for the coming year there would be an increase of $10,000 in expense on account of coal and at least $900 on account of higher labor cost.

It was shown that the Owensville Light Company formerly was able to buy coal at $1.37 per ton delivered, but is now paying $3.25 delivered, and cannot obtain a contract for future delivery. Increased cost of coal and other materials would amount to $1,714 in a year.

J. A. Hillenbrand, Batesville Electric Light & Power Company, testified that his company had bought coal at Cincinnati last year for $1.65 a ton and was paying $3 plus 60 cents freight charges this year. He feared that he would have to pay $4 in the open market.

All of this testimony was based, of course, on conditions prevailing prior to the promulgation of prices by President Wilson.

When these dispatches were written prices of coal in Indiana were still at the exorbitant point to which they ascended last winter and spring.

WAR TAX ON ELECTRICITY STILL OPPOSED IN SENATE

Senator Simmons Expresses Confidence That Senate Will Be Opposed to Any Plan for Taxation of Electrical Energy

It seems clear from reports of the Washington correspondent of the ELECTRICAL WORLD that no tax on electricity will be fastened to the war revenue bill.

Senator Simmons, chairman of the Senate finance committee, who has the war revenue tax bill in charge, made this statement on Aug. 28:

I have not yet been able to ascertain what the House committee, when we go into conference, intends to do. But I believe that the fact that we have important Senators ready to serve on the conference committee when the bill finally goes through would indicate that no matter what the House does the Senate finally will frame its own bill so far as the electricity tax is concerned.

The Senators who will conduct this conference for the Upper House are Stone, Pomerene, Lodge, Williams of Mississippi and myself.

So far as I have been able to ascertain by discussion among the Senators the Senate will be opposed to adoption of any conference report which brings with it a tax upon electricity.

PATRIOTIC ECONOMY TO HELP THE NATION

Everett Morss Says that We Cannot Increase Supply, but Can So Reduce Demands that Available Supply Shall Meet Needs

Everett Morss, president Simplex Wire & Cable Company, Boston, Mass., has sent to a large number of friends in the electrical industry a folder on "Patriotic Economy." It is a direct appeal to practical economy in the national emergency. The discussion of Mr. Morss in full follows:

The necessity for patriotic economy will be evident if we think of finance in terms of labor instead of in dollars. We have natural resources and we have capital invested in the tools of production, but even with these facilities our productive capacity is limited by the supply of labor. By labor we mean the personal service, whether of brain or of brawn, of the 40,000,000 of us who are engaged in gainful occupation.

To carry on the war we shall spend at least $12,000,000,000 per year, or $33,000,000 per day. This is as much as Great Britain is spending and 50 per cent more than Germany is spending, and the figures are so huge that few of us appreciate what they really mean.

Europe is already so deeply in debt that she may never be able to pay, and we are on the road to the same condition. Balance of trade statistics indicate that we have made an extra profit from foreign business since 1914 of $5,000,000,000, or about $2,000,000,000 per year. The effect of this in enriching the country is suggestive of the result of three years of impoverishment at the rate of $8,000,000,000.

Our normal annual savings are about $4,000,000,000, and not only will our war expenditure absorb all of these savings, but we must find $8,000,000,000 in addition. During the last three years our present allies have obtained much assistance from us, but as there is no country to whom we can turn we must carry our burden alone.

Our savings go into public and private improvements, including the extension of business enterprises. These savings will not be available for war until we stop federal, state, municipal and private improvements; until we forbid all issue of securities except under federal license, following the example whereby England reduced the issue of industrial securities from $468,000,000 in the first half of 1914 to $11,000,000 in the same period of 1917.

The danger of a famine has been brought home to us, and we are making a real effort to reduce consumption, though our efforts to increase production are being seriously handicapped by the high price of labor.

Immediately after war was declared the President warned the country that every one should produce more and consume less. The idea that business was to be suddenly reduced by a wave of economy was a shock to business men and the cry "business as usual" was spread over the country and caused the President's appeal to be forgotten. Not only are people spending as usual, but many conscientiously believe it their duty so to do.

Every dollar spent means the consumption of labor. We shall not be far wrong if we say that every $4 spent consumes a day's labor, and that every $1,200 spent consumes a year's labor. A war expenditure of $12,000,000,000 will consume the labor of 10,000,000 people, 25 per cent of our total labor supply. This added demand comes during the greatest labor famine in our history, which has increased commodity prices 85 per cent since 1914.

We have reached a point where the increasing demand reduces the efficiency of labor and thereby reduces the supply, and we are facing a further rise in commodity prices, perhaps to exceed present conditions in England, where prices are up 120 per cent.

The most effective remedy is to decrease consumption, and it is imperative that every one should make a drastic reduction in personal expenditures. The example must be set by the rich, but every man, woman and child must be drawn into the movement until patriotic economy becomes the greatest fad the American people have ever known.

Our young men who try to avoid military service are "slackers." Every one of us who will not economize to help the war is a "slacker." Who will fail to spend less when he realizes that every $4 saved is a day's labor contributed to the war? It is not a question whether your income justifies an expenditure, but whether the country can afford to let you spend.

Even to prevent hardship we have no right to spend to keep people in their usual employment, for only by a process of readjustment can we obtain the labor necessary for the war. Already the government is resorting to price fixing and other dangerous experiments, because we can no longer submit to the law of supply and demand. We cannot increase supply, but we can so reduce demand that the available supply shall meet our needs and so keep prices within bounds.

With 2,000,000 men in cantonments or in tents there are houses enough for the rest of us. We can reduce the famine in wool and cotton by wearing our old clothes. We can stop the purchase of automobiles, so that the factories and their operatives may produce motor trucks, aircraft and munitions. We can use the automobiles we now have less freely and save gasoline. We can reduce the number of our servants and let our wives and daughters do more of the work. We can do away with the wastefulness of charity entertainments if we go less to the theater and give the money saved to charity.

The real horrors in Europe are not on the firing line, but among the civil population, who are pinched for the necessities of life and in many cases dying of starvation. If each one of us is not willing to make sacrifices for the war, Germany was right when she characterized us a "nation of slackers."

PRICE-FIXING SITUATION AT THE NATIONAL CAPITAL

President Receiving Reports from Federal Trade Commission as to Basic Costs of Raw Materials and Production

Within a few days, perhaps before this issue is in the hands of readers, the price of copper will have been fixed. Also within the same period a copper administration may have been established charged with the same duties which have been laid upon the food and the coal administrations. The best information obtainable is that the price of copper will be fixed at between 20 and 25 cents per pound.

This information comes from the Washington correspondent of the ELECTRICAL WORLD, who also reports that within a few days the price of steel also will have been fixed. No positive indication of the price of steel is obtainable at present, although the situation is changing so much from day to day that developments would not be surprising.

President Wilson is apparently doing all the work of price fixing alone. He is receiving from day to day, in his study at the White House, far removed from the White House executive offices, the reports of the Federal Trade Commission as to basic costs of raw material and production on coal, steel, copper, etc.

The curious fact has developed that some of the production figures in regard to cost of labor do not take into account the fact that the labor situation is constantly shifting, and will shift more and more as time goes on and men are sent to Europe from American industries. It is pointed out in Washington that some of the labor now being sent to Europe or which will be sent there later will remain abroad after the war. Some of the expert men in the various engineer

regiments will find life and labor more attractive in Europe after the war, so that it may be stated upon authority of some of the most important Cabinet officers that the whole price-fixing situation resolves itself into a question of conserving labor not only during the war but after it.

President Wilson has fixed the price of coal, and he has created a coal administration, appointing Dr. Garfield, president of Williams College, as its head. This coal administration will take charge of the many details created by coal-price fixing. Washington official life thoroughly expects that in the end it will take charge of all questions of priority of shipments on railroads. Operators have been meeting in Washington during the past week for the ostensible purpose of protesting against the fixing of these prices, but it is well known that underneath the surface the soft-coal operators do not object to the price President Wilson has fixed. When they met in Washington some weeks ago, the Washington correspondent of the ELECTRICAL WORLD reports, they did so with the intention of getting a better price if possible than has been named by the President. They intend to leave Washington satisfied, it is stated in Washington, and their appearance in Washington, it is reported, has been for the purpose of effect.

The fate of the coal production committee of the Council of National Defense, some of whose members have characterized themselves heretofore as members of a coal distributing committee, remains in abeyance. Some of the members may possibly be taken into the coal administration, but there is a general belief in Washington, according to the correspondent of the ELECTRICAL WORLD, that they will not care to enter the coal administration under Dr. Garfield, although it may be stated upon authority that Dr. Garfield will welcome the help of all coal men, no matter what their shades of opinion may be or their past affiliations may have been.

SIGNAL CORPS PURCHASING DIVISIONS TO BE CHANGED

Internal Changes in Buying Arrangements—Expectation of Additional Appropriation of $1,000,000,000 by Congressional Action

A reorganization is in progress in connection with the purchase and supply divisions of the Signal Corps of the United States Army. These divisions, which have been known heretofore as the finance and supply divisions of the Signal Corps, will have added to them within a few days what is to be called the equipment division.

Col. C. F. Wallace, who has been in charge heretofore of the finance and supply division, will become the chief signal officer of the Department of the East, with headquarters at Governor's Island, New York. Robert L. Montgomery, expert accountant at New York, it is understood will be in charge of delivery of materials for the new equipment division, and E. A. Deeds, formerly connected with the automobile industry and also formerly general manager National Cash Register Company, will be in charge of the supply of materials. There seems to be no question that Congress will appropriate in the near future $1,000,000,000 more for the Signal Corps of the Army in addition to the $640,000,000 already appropriated.

TECHNICAL EDUCATION URGED UPON HIGH SCHOOL GRADUATES

Engineers Advise Young Men to Begin at Once Because of World-Wide Scarcity of Engineers Due to War

Leading engineers are unanimous in urging young men, especially high-school graduates, to begin at once on a technical education because of the world-wide scarcity of engineers brought about by war conditions. The South Dakota State College has received many letters from such men.

C. R. Dooley, educational manager Westinghouse Electric & Manufacturing Company, asserts that "the high-school graduate of mechanical talents can serve his country most valiantly by securing a thorough training in engineering or general science, and even though called to the trenches will find his training of inestimable value for leadership. The matter is indeed serious, for if the war continues several years, the Allies may fail for lack of scientific men to plan and construct and direct the efforts of our fighters."

C. E. Skinner, research engineer with the Westinghouse company, spent some time in England in 1915 when the technical schools of that country were practically without students, owing to enlistments for war. He learned from a French scientific commission which visited America that technical schools of that country were almost at a standstill. Therefore, declares Mr. Skinner, the crying need to-day is for engineers, and yet more engineers, both during the war and after its close, and every effort should be made to get increased numbers of men securing an intensive training.

Carl Hering, consulting engineer, Philadelphia, says: "There is no question that technical training is of even greater importance in modern warfare than in times of peace. It is stated that for every man actually engaged on the fighting lines five are necessary elsewhere to supply his needs, and that a very large part of the work of these five is of an engineering character."

A. L. Rohrer, electrical superintendent General Electric Company, Schenectady, writes: "No matter how long or how short the war is to be, we must expect the demands for technically trained men to continue or increase, because buildings, bridges, railways and highways that have been destroyed must be rebuilt and all industrial plants rehabilitated."

Gano Dunn, president J. G. White Engineering Corporation, New York, gives his opinion that "our country will be faced after the war with the most serious industrial competition it has ever had, when we shall need all the technically trained men we can possibly muster. I also believe that technical training will then be at a premium and men possessing it will have more than the usual advantage over men who do not, and unless the high-school graduates start immediately, they as well as the country will not be equipped for success."

South Dakota young men should heed this appeal, in the belief of Dr. E. C. Perisho, president State College. In presenting the advantages of engineering education at State College he says: "If America is to do her full part in this great struggle, we must have a large number of young men who are willing this fall to take engineering work in technical schools. France is now asking the United States to send 10,000 engineers; Russia wants 15,000; China soon will need as many."

SCOPE AND AIMS OF ENGINEERING COUNCIL

Outgrowth of a Real Need for Proper Consideration of General Questions—Work in the War

The American engineering service committee of the Engineering Council has made a public announcement regarding the scope and aims of the council. George J. Foran is chairman and A. S. McAllister secretary of the committee. The announcement is in substance as follows:

The formation of an Engineering Council is the outgrowth of a real need for proper consideration of questions of general interest to engineers and to the public and to provide the means for united action upon questions of common concern. This war has brought out very impressively the actual need for united action. At present the council is concerned with only four societies because that seemed the most practical way of getting a group of men together to answer the immediate needs, but these societies do not assume to speak for all engineering societies in the country. Criticism that they are exclusive in any way is utterly mistaken. There is the hope that such a council by proving itself effective may lead to much wider co-operation in a strictly representative body for all engineers, and thus pave the way for a very much larger union in the future.

How can the council be enlarged? By a union of all societies either as the outgrowth of the present council or by a congress of engineers leading to united action by all societies. The first method will be the most natural one because many local societies and national societies also have a large membership in the four societies at present concerned. We have three classes of engineers to reach—first, those who are members of local societies and not members of national societies; second, those who are members of national societies and not members of local societies, and, third, those who are members of no society. The last-named class constitutes a very large number in our profession. We are almost as mixed as American citizenship, and we suffer therefrom just as much as America, with a population representing every race and every people in Europe. There can be no question of the enormous advantage of union. That union should be completed by strengthening the existing agencies and not by the formation of new societies. The national societies are thoroughly national, notwithstanding an occasional complaint that they are run by New York. If they have not been able to express the democratic spirit of our country as fully as might be desired, it is the fault of the members in all the states and not of the city in which the principal offices are located.

The four societies concerned at present are the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers. They have come together in pairs from time to time in the past for special purposes, and there have been general conferences on subjects requiring immediate settlement, but until the council was organized in June there was no permanent body to advise all the societies. We have had many fruitful discussions in the past leading to useful action. The standardization committee, representing five societies, has passed upon commercial standards of all kinds.

Many problems have already been presented before the council. The first duty was necessarily the organization and appointment of standing committees which have already been reported in the press. They might with advantage be mentioned here:

1. Committee on public affairs—C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice.

2. Committee on rules—J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus.

3. Committee on finance—B. B. Thayer, I. E. Moultrop, Calvert Townley and Alex. C. Humphreys.

Certain questions relate, however, to the war and the assistance that engineers can render. A committee, to be called the American engineering service committee, was appointed with instructions to invite the co-operation of all engineering societies. This committee in the first instance consists of A. D. Flinn of the Civil Engineers, A. S. McAllister of the Electrical Engineers, George J. Foran of the Mechanical Engineers, G. C. Stone of the Mining Engineers and E. B. Sturgis of the Mining and Metallurgical Engineers. Its present duty is the tabulation and listing of the members of the five societies represented, in order that we as a profession may be in a position to take a larger part in the industries after peace is declared. This tabulation has already been done in part, but in a rather unsystematic and unequal way.

It is hoped that the new committee, by having additions from other societies, may make a final and lasting tabulation of all the engineers in the United States. The list is to be kept in the Engineering Building for general use in government problems and in the industries. At present the committee is devoting its attention to the immediate need of the hour, namely, the procurement of men for special service in the government. Already a list of specialists in the societies has been completed. There are three methods by which engineers may enter United States service—first, through some organization; second, through individual application to a department of the government, and, third, through selection by the conscription law. But this is war service wholly and not civil service, which is the same now as it has always been. As a matter of fact, a great many engineers have already entered through the engineering societies, through colleges and through various special boards in Washington. The importance, however, of a complete list of engineers and their professional specialties cannot be overrated. Such a complete list can be made only with the help of the local as well as of the national societies. The committee mentioned above is organized with George J. Foran as chairman and A. S. McAllister as secretary.

Another committee, of which Harold W. Buck is chairman, is called the war committee of technical societies. The members are H. W. Buck, A. M. Greene, R. N. Inglis, C. R. Corning, G. C. Stone, D. W. Brunton, J. M. Boyle, J. V. Davies, Joseph Bijur, A. S. McAllister, W. D. Richardson and Charles Baskerville. It was appointed to assist any organization in Washington—such as, for instance, the Council of National Defense, the National Research Council and the Naval Consulting Board.

A council organized by the enlargement of the present Engineering Council can be very effective in many ways, without interfering with the autonomy of any individual society. Every society has some definite purpose of its own and also some which it holds in common with all other societies. One of the latter purposes relates to public service and to co-operation. To the end that all societies may understand fully their opportunity, the committee of which Mr. Foran is chairman has made a complete list of all the societies and their officers, and communications will be sent out inviting co-operation, and it is hoped that the council may be successful in arousing sufficient interest to bring about a larger and better council for all engineers.

In organizing the council provision was made for the election to membership of other national engineering and technical societies.

The office of the council will be in the Engineering Building, 29 West Thirty-ninth Street, New York.

CALVERT TOWNLEY, secretary, 115 Broadway, N. Y.
IRA N. HOLLIS, chairman, Worcester Polytechnic Institute.

MEMBERS OF THE ENGINEERING COUNCIL

United Engineering Society—Clemens Herschel, B. B. Thayer, I. E. Moultrop; Calvert Townley, secretary.

American Society of Civil Engineers—John F. Stevens, George F. Swain, vice-chairman; Fred H. Newell, Alex. C. Humphreys, John D. Galloway.

American Institute of Mining Engineers—P. N. Moore, S. J. Jennings, B. B. Lawrence, J. Parke Channing, Edwin Ludlow.

American Society of Mechanical Engineers—Dr. Ira N. Hollis, chairman; John H. Barr, Charles Whiting Baker, Arthur M. Greene, Jr., Dr. D. S. Jacobus.

American Institute of Electrical Engineers—H. W. Buck, vice-chairman; E. W. Rice, N. A. Carle, P. Junkersfeld, C. E. Skinner.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

George E. Willard, Quakertown, Pa., has resigned as superintendent of the local municipal electric plant.

Andrew W. Rogers has been elected president of the Beverly (Mass.) Gas and Electric Light Company, succeeding the late Sidney Winslow.

G. W. Johns has been appointed manager of the Newton Gas & Electric Company, Newton, N. J., tendering his resignation as manager of the Boonton Gas Light & Improvement Company, Boonton.

M. S. Sloan has been appointed vice-president and general manager of the New Orleans (La.) Railway & Light Company. Mr. Sloan, who is a graduate of the Alabama Polytechnic Institute, first entered the employ of the General Electric Company. During the summer of 1906 he was made chief engineer of the Birmingham (Ala.) Railway, Light & Power Company. He was soon promoted to assistant superintendent of the lighting and power departments of the

M. S. SLOAN

company and in 1907 to superintendent of power. In the following year he became superintendent of the electric department and in 1910, upon his appointment as assistant to the president, he assumed supervision over all departments. Toward the end of 1913 he became connected with the New Orleans property, an affiliated company, as assistant to the vice-president. A few months later he became manager of the railway and electrical departments of the New Orleans Railway & Light Company.

George W. Bunnell, president of the Power Construction Company, Worcester, Mass., has been elected colonel of the First Regiment of Engineers, Massachusetts, formerly the First Corps of Cadets, Boston. Colonel Bunnell is a graduate of West Point, class of 1899, and after several years of military duty was for some time associated with J. G. White & Company, New York, in engineering and construction service. He was in charge of the construction of the hydroelectric power plants of the New England Power Company in the Deerfield River Valley in Massachusetts and Vermont.

H. C. Holt has resigned as chief engineer at the Prosser plant of the Pacific Power & Light Company.

Stacey C. Richmond, formerly a director of the Niagara Falls (N. Y.) Power Company, has been elected president of the company. He succeeds E. A. Wickes, who has retired.

Frank G. Tappan, formerly instructor in electrical engineering at Cornell University, has been appointed associate professor of electrical engineering at the University of Oklahoma, Norman, Okla., succeeding Lester W. W. Morrow.

Lester W. W. Morrow, who has been associate professor of electrical engineering at the University of Oklahoma and acting head of the department the past year, has been made professor of electrical engineering and head of the department, succeeding Professor Bozell.

F. H. Lane, manager of the department of examinations and reports of H. M. Byllesby & Company, will have temporary charge of the engineering and construction department, succeeding W. R. Thompson, now a captain in the United States Army, stationed at Battle Creek, Mich., and A. H. Sayce, who has joined the Second Officers' Reserve Camp at Fort Sheridan.

Prof. A. M. Buck, who for the last six years has been in charge of the electric railway courses at the University of Illinois, has resigned to join Mr. John A. Beeler, of 52 Vanderbilt Avenue, New York City, in the consulting field. Professor Buck was born in Washington, D. C., in 1881, and received his early education in the public schools of that city. He received his technical education at Sibley College, Cornell University, graduating with the degree of mechanical engineer in 1904. He was instructor in electrical engineering at Cornell for one year, assistant professor of electrical engineering at New Hampshire College for two years, and professor of electrical engineering at the Clarkson School of Technology for one year, previous to assuming his duties at the University of Illinois. He was also connected with the D., L. & W. for a short period, and has held positions in the engineering departments of the Westinghouse Electric & Manufacturing Company and the Mechanical Appliance Company. He is the author of "The Electric Railway," a standard text-book, and a number of articles which have appeared in the technical press from time to time. Professor Buck is a member of the American Electric Railway Association, the American Institute of Electrical Engineers and the Society for the Promotion of Engineering Education, and is a fellow of the American Association for the Advancement of Science. He also received the degree of electrical engineer from the University of Illinois in 1917. His new work will consist largely of investigations dealing with the construction, operation and management of electric railway properties.

Obituary

Ernest Harlan Haughton, general manager of the Bryan-Marsh division, National Lamp Works of General Electric Company, Chicago, who together with his wife lost his life on Aug. 22 when on an automobile tour through the Adirondacks, was a graduate of the University of Nebraska in the class of 1895. He started his career as an inspector with the Underwriters' Electrical Testing Laboratories. He remained but a short time, when he decided to enter the field of salesmanship,

E. H. HAUGHTON

in which he was active until his death. On Sept. 1, 1901, he entered the incandescent lamp business, selling lamps at first in Southern territory. On Jan. 1, 1902, Mr. Haughton resigned from the Morgan Lamp Company and joined the Bryan-Marsh Company, which he served in the capacity of a salesman from that date until the following October, when he became manager of the company's Cincinnati branch. He continued in this position until Jan. 1, 1904, and on Aug. 1, 1904, he became manager of the company's main office at Chicago. The funeral was held at Henderson, Ky.

Arthur Kneisel, national treasurer for the American Association of Engineers, died in Chicago on Aug. 17. He was one of the original promoters of the association and was secretary up to this year. Mr. Kneisel was born in Lexington, Ky., in 1880, and received his early education in the Lexington schools, later graduating from the University of Kentucky. He went to Chicago more than fifteen years ago and was engaged as a telephone engineer and patent attorney. At the time of his death he was president of the Utilities Development & Sales Company.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Report of Merchants' Heat & Light Company, Indianapolis.—The Merchants' Heat & Light Company, Indianapolis, has filed its annual report for the year ended June 30 with the Indiana Public Service Commission. The total operating revenue was $1,199,668, of which $313,418 was from steam and hot-water heating. The report shows a total of 52,171,800 kw.-hr. generated during the year, of which 39,099,539 kw.-hr. was sold.

Increasing Use of Electricity in Hawaii.—During the last year 500 electric light connections have been added to the system of the Hilo (Hawaii) Electric Light Company, and forty electric ranges, eighty-five water heaters and about 1000 socket appliances have been sold. The motor load has been increased by 600 hp. This company, which is the only electric company on the island, has a rating of about 2000 kw. The company has ordered a 1000-hp. generator to be operated by water power, which is to be added to its present plant. Still another water-power development is contemplated. New equipment has been ordered for reconstruction of the street-lighting system at a cost of about $5,000.

Limitation of Imports of Electrical Equipment. — United States Consul General George H. Murphy, Cape Town, South Africa, reports that the Cape Town Chamber of Commerce has received the following letter from the Secretary for Mines and Industries: "In view of the position in which the electrical industry of the United Kingdom is placed in regard to its export trade, owing to restrictions of manufacture and exportation involved by the war, it is desired to call the attention of your chamber to the desirability of deferring as far as possible the calling for tenders for electrical machinery and equipment for public contracts until the conclusion of hostilities."

Power for Oil Pumping in California.—A. G. Balch, vice-president San Joaquin Light & Power Company, Fresno, Cal., is quoted as follows: "The strong financial position of the company and the rapid extension of its system might be attributed in a measure to the power demanded by the various oil companies for pumping purposes. To give an idea of the magnitude of this business, we have expended in the neighborhood of $1,000,000 so far this year for extensions to take care of new business, necessitating the use of 700,000 lb. of copper, which in itself is a considerable item at present prices. The San Joaquin company is now serving 1500 wells, or 10 per cent of the wells in the field. Owing to the lack of transformers over 200 wells contracted with cannot be supplied with power. We are serving all of the larger companies, which find that it is profitable to pump with electric power when oil is selling above 35 cents a barrel in the field. Electric installation costs about $500 per well, gas engine equipment about $900 and steam equipment about $1,200. Aside from the original cost and the saving in power, one man can take care of from sixteen to twenty electrically equipped wells and only of eight gas or four steam rigs. The last item in itself is a considerable saving."

Consolidation in Indiana.—R. E. Breed, president Indiana General Service Company, Elwood, has filed with the Indiana Public Service Commission a petition for authority to merge several properties. The Indiana General Service Company, it is proposed, will purchase the Marion Light & Heat Company and the Muncie Electric Light Company. The petition asks authority for the issue by the Indiana General Service Company of $3,000,000 common stock and $207,700 preferred stock, with $3,359,500 bonds. These are to be used to retire bonded indebtedness and stock of the companies. Mr. Breed said that no increase in capitalization of the companies was involved.

New Zealand Water Power Development.—The chief electrical engineer of the public works department of New Zealand has recommended that three sources of water power should be developed in the North Island—Lake Waikaremoana for the Hawks Bay district; Arapuni Gorge (about 8 miles from Horahora), or some other place to be selected, for the Auckland district; and the Mangahao River for the Wellington district. The Wellington plan for 25,000 hp. will cost about $5,000,000 and the Auckland plan for 30,000 hp. about $6,000,000. It is recommended that the development of Lake Waikaremoana should be deferred for the present, and that the Auckland and Wellington schemes should proceed simultaneously.

Hydroelectric Development in Spain.—United States Consul General Carl Bailey Hurst writes from Barcelona: "The growing need of coal in Spain has emphasized the importance of utilizing more generally the hydraulic power available in this country. Although the conversion of hydraulic power into electric energy has greatly developed in the Peninsula during recent years, it is estimated that at present not more than 8 per cent of obtainable hydroelectric force is employed. Could more capital be invested in the exploitation of resources, the electrification of the railroads and manufacturing plants of Spain would be easy. The Unión Eléctrica Española publishes statistics showing that 170 hydroelectric plants operated in Spain have 881,174 hp. available, with only 384,297 hp. exploited. As the figures given do not include quite all such plants, it is estimated that the force exploited yields 400,000 hp. at present and will reach 500,000 hp. when work already under way has been completed. The capital invested in hydroelectric enterprises amounts to $300,000,000. Most companies work on comparatively small capital, only six of them being capitalized at over $4,000,000. The most important is domiciled in Barcelona and already disposes of about 100,000 hp. Next in importance is a French company, which utilizes twenty-four natural lakes."

Electric Announcer at Dutch Auctions.—Paul L. Edwards, clerk to the United States commercial attaché at The Hague, writes that at the regular trade auctions in the Netherlands, instead of having an auctioneer call for bids, a large dial is provided with an index hand. The face of the dial is marked with prices, increasing in clockwise fashion. The hand is set at a price above that which the goods offered will probably bring, then is slowly moved to lower and lower figures until some trader indicates willingness to buy. Electric push buttons are connected with the dial, which traders press when a price satisfactory to them is shown. As the trader presses his button his number appears on the face of the dial and the lot of goods is sold to him at the price indicated.

Oregon Commission Asked to Prevent Competition.—Complaint has been filed with the Oregon Public Service Commission under the public convenience and necessity clause of the law by the North Coast Power Company against the Portland Gas & Coke Company, asking that the Portland company be required to cease invading the Tulatin Valley in competition with the plaintiff without having first obtained a certificate of public necessity. The North Coast company has operated in the Tulatin Valley since Sept. 29, 1915, furnishing electricity for heating and lighting in Garden Home, Beaverton, Orenco, Hillsboro, Cornelius, Gaston and Dilley, and it declares that the Portland company is extending its plant into the territory where it had not served previous to May 21, 1917, and that such extension will cause a duplication of electrical service equipment.

Electric Central Station in India.—United States Consul Lucien Memminger, Madras, writes that the English concern of Best & Company, Ltd., First Line Beach, Madras, has applied recently to the government for a license to establish an electric lighting and power plant in Madura, 344 miles from Madras. Madura has 134,130 inhabitants and next to Madras is probably the most important city in South India. At present it has no electric power establishment or modern lighting system. If the license is secured, the scheme will be the most important of its kind in all this part of India with the exception of the lighting systems at Madras and at Bangalore, Mysore. All public lighting in Madras and Bangalore is by electricity, there being no gas-lighting companies in this district. Petroleum and lamps with vegetable oils are used to a considerable extent.

American Telephone Service. — An American officer landed from one of our ships at a certain port in France. He hurried to a post office to telephone to Paris. "Your number," said the employee, "is twenty-three." "What do you mean by that?" the officer inquired. "There are twenty-two ahead of you." "How long will it take?" "They average about ten minutes apiece." The officer departed. Five days later there were nine new telephone lines to Paris from that port. This incident is reported by Norman Hapgood in the New York *Evening Post.*

Increased Rates Asked by Rome (Ga.) Utility.—The Rome (Ga.) Railway & Light Company has sought the permission of the Georgia Railway Commission to increase its rates. The company seeks to raise the minimum bill from 50 cents to $1 a month, to add 1 cent per kilowatt-hour to the respective quantities used per month, to have a base rate of 10 cents per kilowatt-hour for the first 100 kw.-hr. and a minimum rate of 6 cents for all above 1000 kw.-hr., to increase the rate for sign-advertising lighting from 5 cents to 6 cents, to increase the minimum bill for motor service from 75 cents to $1.50 per month, and to add 0.5 cent per kilowatt-hour to each class of motor customers.

Restricted Supply of Electrical Energy at Hongkong.—United States Consul General George E. Anderson, Hongkong, British China, writes: "A public service corporation rarely is able, as the result of a year's business, to declare a dividend of 30 per cent on its stock, place one-sixth of the amount of its paid-up capital to increase its reserves, write off its plant account more than one-third of the amount of its stock, and be compelled to call upon its patrons, the public, not to use its product so freely. Nevertheless, this is the record of the Hongkong Electric Company, Ltd., which supplies electric light and power for the principal portions of the colony as distinct from another concern which serves Kowloon and the mainland of the colony. The unusual business condition arises from the great increase in the use of electric light by Chinese residents of Hongkong and from the inability of the company to obtain the equipment needed to complete a new plant it has had under construction. Apparently no effort has been made by the concern to get the equipment in the United States."

Extension of Electrical Systems in England. — United States Vice-Consul Hamilton C. Claiborne, Bradford, England, writes: "Much attention is being given to the investigations and recommendations of the committee appointed by the board of trade to report upon the possibilities of extending and interconnecting various sources of supply and providing economical and convenient electric power for British industries. The full report of the committee is not yet available, but a great deal of discussion upon the subject has recently appeared in the English press. It is suggested that a national power distribution system is as important as national railway, road, telegraph and telephone systems, and stress is laid upon the advisability of insuring that there shall be an adequate and economical supply of power for all classes of consumers in the United Kingdom, particularly industries that depend upon a cheap supply of power for their development. The intercommunication of existing municipal electrical plants and the establishment of central generating stations are among the questions now being given practical attention."

Southern California Edison Stock Offering.—The Southern California Edison Company has applied to the California Railroad Commission for authority to enter into subscription contracts with employees so that they may become shareholders on a special payment plan. The company still has unsold 21,174 shares, par $100, which it offered to stockholders at 88. The stockholders bought 3826 of the 25,000 shares offered, and the company wants to sell 7000 shares to department heads and officers and 5000 shares to other employees, and the remainder of the 25,000 shares to the general public, if the employees do not care for more. To officers and department heads it wants to offer the shares on a payment of 7½ per cent of the purchaser's salary each month, with 6 per cent interest on unpaid shares, dividends to be retained and credited. The entire balance of the purchase price must be paid by Oct 1, 1922. To general employees the company offers the same terms, but without limitation as to time of final payment. Employees are to pay 88 a share and the general public 89 per share cash or 90 in installments.

Hydroelectric Development in Sweden.—United States Consul B. M. Rasmusen writes from Gothenburg, Sweden, that owing to the scarcity of coal and coke hydroelectric power plants are being extended and new plants constructed with all possible speed. The government hydroelectric power plant at Trollhättan is being enlarged by eight new machine units. The flow from Lake Vänern will be regulated at an expense of $3,484,000, and a new power plant near Trollhättan is to be built. The government Water Power Board has drawn up a preliminary contract for the delivery of 12,000 kw. from the power station at Trollhättan to the Aktiebolaget Elektro-Saltpeter, at Stallbacka, which plans to manufacture nitrogen products by the Norwegian Birkeland-Eyde electric methods. The minimum capital stock, $857,600, has been subscribed; the maximum will be $2,572,800. Production is estimated at 7000 tons per annum. A high-tension electric transmission line is to be built from the government transforming station at Alingsas to a new transforming station at Sjömarken to provide electric power for several factories. Another company was organized at Hessleholm for building a hydroelectric power plant to distribute current. Committees were appointed to investigate the utilization of electric power for agricultural purposes.

Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 461 of this number.

Denver Section, A. I. E. E.—At a recent meeting of the Denver Section of the A. I. E. E. the following officers were elected: Chairman, Norman Read; vice-chairman, Fred J. Rankin; secretary-treasurer, Robert B. Bonney. R. G. Griswold delivered an address on "The Development of Gas versus Electricity for Domestic Uses."

Long Island Contractors Meet.—Forty Long Island electrical contractors met at Babylon, L. I., recently and formed the Association of Electrical Contractors of Long Island, with a view of affiliating with state and national associations at some future time. The officers chosen were R. M. Mansfield, Babylon, president, and S. Howard Titus, Patchogue, secretary.

Activities of Panama Engineers.—The Panama Section of the A. I. E. E. elected the following officers for the coming year: Chairman, C. J. Embree; vice-chairman, E. D. Stillwell; secretary-treasurer, W. F. Kleene; executive committee, E. S. Guild, H. W. Jacobsen and R. D. Prescott. Captain T. H. Dillon gave an outline of the conditions under which an engineer regiment might be formed on the Canal Zone. At a later meeting of this section the following papers were presented: "Inspection, Tests and Specifications for Lock Equipment," by C. J. Embree, and "Galvanic Action Between Metals, and Life Tests of Paints," by F. B. Coyle.

Oregon Contractors to Meet. — The second annual convention of the Oregon Association of Electrical Contractors and Dealers will be held on Sept. 17-18 at Eugene, Ore. The important addresses of the meeting follow: Address of welcome, by J. E. Shelton, editor Eugene *Guard* and chairman of publicity and convention bureau of the Eugene Chamber of Commerce; response, F. C. Green of Portland, Ore., president Oregon Association of Electrical Contractors and Dealers; paper, "Business Methods and Outlook," by C. D. Rorer of Eugene, president Bank of Commerce of that place; address, "Oregon's Electrical Industry," by Franklin T. Griffith of Portland, Ore., president Portland Railway, Light & Power Company; paper, "The Need of Proper Electrical Inspection and How to Organize an Electrical Inspection Department," by F. Dunlap of Portland, Ore., chief electrical inspector of the bureau of buildings of that city; paper, "The Electrical Jobber," by J. I. Colwell, Northwest manager Western Electric Company of Seattle, Wash. A good attendance is expected.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

SELLING BY MAIL IN WHOLESALE QUANTITIES

Several Electrical Manufacturers Are Now Trying This Method with a Gratifying Amount of Success

At the present time, owing to enlistments, the draft and other causes, there is a very noticeable shortage in salesmen. Help wanted columns in the daily papers show an ever-increasing call for salesmen in every line. The electrical line, of course, feels this condition as well as the others. As a result some manufacturers and large distributers have been trying out the mail method of selling. No attempt is made to hide the facts. The customer is told that he can save both himself and the company time by doing his business by mail. The results obtained, it is understood, have warranted a further use of the mails for sales purposes under the abnormal conditions that have now to be met.

A report from one company that tried this plan with its smaller customers shows that out of 100 cards mailed out fifty-six replies were received within two weeks, resulting in eight orders. In this case the goods for sale were different kinds of switching equipment. In this particular case the manufacturer offered immediate deliveries as an additional inducement to customers to take advantage of the new method of selling electrical goods.

PRICE-FIXING PROGRAM CAUSES UNCERTAINTIES

Business Falls Off and Prices Remain Stationary—Possibility of Establishing Premiums for Delivery

There have been fewer changes in prices on electrical goods during the past two or three weeks probably than in any other period of similar length in the past two years. In addition, for the first time in that period there has come a lull in buying, and demand outside of government orders has fallen below normal.

In no small amount can these conditions be traced directly to the uncertainty that exists regarding the ultimate goal of the government in its price-fixing scheme. The action taken in connection with coal has been interpreted as an indication of the procedure that may be expected in other directions.

Should the government fix maximum prices on raw materials much lower than prevailing prices, there is no small belief that it would act to prevent higher prices of manufactured products and in some instances even force a reduction. Consequently manufacturers hesitate to make any move, and buyers are loath to lay in stocks that may at any moment depreciate in value owing to a falling market. That this latter action is taken in the face of winter approaching, with the railroad situation not all that is to be desired, and realizing that the railways will undoubtedly be under a more severe strain with the national army in training, is significant.

However, there is another phase of the situation that is being taken into consideration. The fundamental economic law of supply and demand, it is felt in many quarters, will continue to obtain, the government notwithstanding.

The prices to be fixed by the government, if present indications can be relied on, will, if lived up to, prevent certain producers from operating. It is well known that certain copper mines that have a very considerable production cannot produce copper for less than 20 cents. On a 22.5-cent basis they would probably cease to operate, for the 2.5 cent and less margin that this would mean would hardly be worth the risk of operating.

Therefore it is argued that production will be cut down. On the other hand, the government has promised to stimulate production, and consequently a way out is being sought by the trade and there is a strong belief that the way out will be through premiums.

In other words, the quoted price will conform to the government's maximum, but in order to obtain delivery in any acceptable time it probably will be necessary to pay a premium sufficient in amount to provide a return more commensurate with the risk and demand. The delivery situation, therefore, will be the controlling factor.

Should this situation occur, it is doubtful if any decrease in price can be expected, and in fact when such a scheme is resorted to there are reasons to believe that even higher prices may obtain.

CASH DISCOUNT SITUATION UNDER INSPECTION

Practice Has Been Found Open to Many Abuses Which Manufacturers Are Now in a Favorable Position to Correct

Wholesale distributers of electrical goods are turning their attention to the so-called cash discount in an effort, if not to abolish it, at least to have the terms of it exactly understood by those who would take advantage thereof. The cash discount really is not a discount, but is rather a premium for prompt payment. It costs considerable to have bills outstanding, and the distributer has been willing to recognize this, not by selling to the prompt payer at a smaller amount, but by returning to him a certain amount of the purchase price when the account is paid within a certain definite time.

This system, however, is open to many abuses which in the almost non-competitive market of to-day the distributer is in an admirable situation to correct. Buyers, many of them, believe that, although the cash discount terms are, say, 2 per cent ten days, it does not really matter if eleven or twelve days are taken. They send in their check with the discount subtracted. Of course, in a number of cases, perhaps most cases, the distributers have been to blame, for they have accepted the amount and receipted the bill.

It is safe to say, however, that more and more distributers are becoming firmer and refusing to allow any credit unless the full terms are complied with. It is manifestly unfair for some to be lax while others are firm, but the number of lax ones is diminishing rapidly.

In fact, the entire practice is meeting with less and less favor among the manufacturers. Already many have dropped this practice, and a number of others are contemplating doing so. It is doubtful, however, if the industry is yet ready as a whole to abolish the practice of cash discounts.

The Electrical Supply Jobbers' Association at its recent meeting held at Hot Springs, Va., adopted the following resolution:

"Resolved, That it is the sense of this meeting that the discontinuance or reduction by manufacturers of cash discounts to distributers would be detrimental to the best interests of the jobbing industry."

RAPID GROWTH IN EXPORTS OF ELECTRICAL APPARATUS

Compilation Shows Increasing Demand from All Parts of the Globe for Merchandise of American Manufacture

American electrical apparatus is gaining rapidly in popularity the world over. A compilation by the National City Bank of New York shows that the value of electrical machinery, appliances and instruments exported from the United States in the fiscal year 1917 aggregated more than $50,000,000 against $30,000,000 in 1916, $20,000,000 in 1914, $10,000,000 in 1911 and $6,000,000 in 1900.

Of the nearly $2,000,000 worth of telephones exported in the fiscal year 1917, more than $100,000 worth went to Asia, about an equal value to South America, nearly $100,000 worth to Oceania, $300,000 worth to our North American neighbors, and practically $1,000,000 worth to Europe, the total of telephones exported in 1917 being twice as great in value as in 1912. Of the nearly $500,000 worth of electric fans exported in 1917 the largest market was in India, while Hongkong, the Straits Settlements, China, Japan, and even Siam, were also large buyers.

Electrical apparatus of all sorts sent to Asia increased from $1,000,000 in 1910 to approximately $2,500,000 in 1917; to Africa, from $298,000 in 1910 to more than $500,000 in 1917; to Oceania, from $650,000 in 1910 to approximately $2,500,000 in 1917, and to South America from about $3,000,000 in 1910 to approximately $4,000,000 in 1917, while the total of 1917 is nearly ten times as much as in 1900 and thirty times as much as in 1890.

METAL MARKETS CONDITIONS

Prices Still Softening in Anticipation of Government Price Fixing

There was a general softening in the quotations for different metals in the New York market last week. Probably the most conspicuous factor was the government price-fixing program. Based on the prices fixed for soft coal and later for hard coal, dealers in metals foresaw much lower prices for metals than had formerly been expected. In some quarters a price as low as 20 cents would not be surprising, although the consensus of opinion within the trade is that a price in the neighborhood of 22.5 cents may well be expected. There seems to be no doubt now that the price to the Allies will be the same as the price to the United States government. All of this has had the effect of forcing the market down, so that 25-cent spot copper seems now only a matter of a few days.

Copper prices of course are nominal, and actual purchases can be made only on a bargain between buyer and seller, which in most cases represents higher prices than prevail in the daily market quotations. Quotations on electrolytic were quoted nominally on Monday as follows: September, 26 cents; October, 25.5 cents; fourth quarter, 24.75 cents.

NEW YORK METAL MARKET PRICES

	Aug. 20	Aug. 27
Copper:	£ s d	£ s d
London, standard spot	120 0 0	120 0 0
Prime Lake	....	27.00 to 28.00*
Electrolytic	....	26.00 to 26.50*
Casting	....	25.50 to 26.00*
Wire base	34.00 to 37.00	32.00 to 33.00*
Lead, trust price	11.00	11.00
Nickel, ingot	....	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	8.40	7.92½ to 8.30
Tin, Straits	62.75	61.50
Aluminum, 98 to 99 per cent.	....	44.00 to 46.00

OLD METALS

Heavy copper and wire	25.00	24.00 to 25.50
Brass, heavy	16.00 to 16.50	15.00 to 15.50
Brass, light	12.50 to 13.00	12.50 to 13.00
Lead, heavy	8.50 to 9.00	9.00 to 9.25
Zinc, old scrap	6.25 to 6.75	5.50 to 6.00

*Nominal.

THE WEEK IN TRADE

THERE was practically no change in the volume of business in electrical materials during the past week from that experienced during the two or three previous weeks. It is very evident, however, that regular business is falling off, the gap being closed by government orders. Fall business is opening up a couple of weeks earlier than usual, probably on account of the delivery situation. Prices remained stationary during the week. It is doubtful if any considerable amount of price change will be evident until the government makes known its decision regarding maximum prices for raw materials, particularly copper and iron and steel.

NEW YORK

Business from regular directions has fallen off considerably of late. Total demand probably will be found to be maintained, but only on account of the tremendous buying for government work. Some factories are doing nothing but government work. It is probably true that some of the let-up in incoming orders is due to a realization of the congested condition of the factories working on war contracts and a consequent deferment of purchases until it is possible to talk deliveries.

Ordinarily there is a lull at this time of the year, but now in comparison with the flood of incoming business that was experienced in previous months of the year the falling off appears much larger.

While the government's program on price fixation took on a broader aspect during the week, and while the intentions of the government seemed more apparent, there was still a large amount of uncertainty and very few changes in price occurred. There seems to be considerable doubt expressed that the government can maintain its announced program and still stimulate production.

The growing scarcity of salesmen is particularly noticeable. A number of salesmen have enlisted; others have been drafted. For these and other reasons there are a large number of sales positions open.

INCANDESCENT LAMPS.—Fall business opened a week or two earlier this year than ordinarily and there is now a good demand. Deliveries are good. Some factories are having a hard time filling orders in certain types, but this deficiency is made up by an exceedingly strong position in other types.

FLASHLAMPS.—Total demand is very large, but this includes some government contracts. With the dealers, however, business is pretty quiet.

BELLS AND GONGS.—Except for government work business is soft. The scarcity of new building is particularly discouraging to this line.

MOTORS.—There has been a decided slump in incoming orders for small motors locally. One manufacturer estimates the falling off to be in the neighborhood of 25 to 35 per cent. Prices, however, are still increasing, another advance in the neighborhood of 15 per cent having taken effect within the last few weeks. Export demand is picking up, and it is felt that present inquiries should develop into an excellent foreign trade during the fall months.

OUTDOOR LIGHTING FIXTURES.—Business at present is unusually good, with a very considerable demand for units for lighting government cantonments and camps. The call for ornamental lighting equipment is also good, some very large jobs being reported. Export inquiries are better and a good trade is under way. Prices continue to advance. In fact, almost every month advances of some kind are announced.

LIGHTING GLASSWARE.—Another increase was announced early in August. The fall season is now opening up and a good demand is noticed. Automobile headlamps are moving very fast.

PROJECTORS.—Business has fallen off perceptibly, although the outlook appears promising. Some of the manu-

facturers have recently advanced prices and other advances are looked for.

WIRE.—There is little change in the copper wire situation. Most manufacturers are quoting on either 36-cent or 37-cent base, with one on 35 cents and another on 38 cents.

HEATING APPLIANCES.—The Hotpoint Electric Heating Company has sent notices to the trade announcing an advance in prices of chafing dishes, grills, heaters, percolators, tea kettles, toasters and immersion heaters, effective Sept. 5.

WATERWHEELS.—One large manufacturer of waterwheels reports that its plant is running to its full capacity, a large part working day and night. Collections are exceptionally good. No new business is being solicited, by reason of which very few orders are being booked; the company, however, has business enough to keep it going for the next year; the number of employees is greater than it was a year ago, and the operating conditions are favorable.

CHICAGO

Jobbers report business somewhat better during the last week, with increased requests for quotations. The opinion is frequently expressed, however, that manufacturers' prices are being raised unduly and that general construction will remain at a standstill until the markets become more settled. There is also a feeling that all energies should be concentrated on filling government demands before making extensions not essential to the war.

Possible legislation on steel and copper prices is adding to the uncertainty of the market. If prices are fixed, orders now held in abeyance will be released whether the price level is high or low.

CABLE FITTINGS.—Manufacturers of devices for overhead and underground distribution report unusually heavy business. The July, 1917, business of one manufacturer was over six times that of July, 1916. Part of the demand is probably due to central-station extensions to industrial plants having war orders.

ELECTRIC RANGES.—Business is steady and government orders are mostly completed.

WASHING MACHINES.—All manufacturers report a very heavy demand.

SECOND-HAND MACHINERY.—Dealers are having good sales, but are experiencing considerable difficulty in obtaining equipment.

METERS.—The demand is steady and deliveries are good except in larger sizes.

TRANSFORMERS.—Deliveries are very poor. Manufacturers are unable to promise shipment on some sizes in less than twelve months.

LIGHTING FIXTURES.—The general trend is toward steel-stamped fixtures. Business in this type will undoubtedly increase as manufacturers are able to install the necessary machinery and develop manufacturing methods. The general tendency is to push sets in standard packages.

MINE LOCOMOTIVES.—The Calumet & Hecla Mining Company has placed an order for thirty-one Goodman locomotives, each equipped with forty-eight cells of "Ironclad-Exide" batteries.

BOSTON

The volume of trade has continued to slow up somewhat in New England electrical circles during the past week, and not much increase is anticipated until after Labor Day. The tide of vacation travel is beginning to turn toward the cities, and some increase in inquiries is noted by dealers in fixtures and other domestic supplies. Prices remain steady and collections are reported a trifle slower. Indistrial demands are very active. Central stations report a good summer in respect to appliance sales. A number of active campaigns are planned for early fall. Government work is increasing in volume, and in some quarters the view prevails that federal price regulation under the food control bill may lead to some reduction in the cost of raw materials used in the electrical industry. At least, there is some reason to think that higher prices will be deferred for some time unless the actual draft of men for overseas service proves more serious than at first appears likely. There is already a marked shortage of labor in electrical manufacturing.

LAMPS.—Prices remain firm, with a heavy volume of business. It is said that better service has been given to the trade this year by lamp manufacturers than by any other producers of electrical apparatus. Deliveries are good at present. It is expected that there will be a shortage in lamps this fall, although strenuous efforts are being made to increase production facilities. This fall one factory in Boston will have increased its production rate from 48,000 to 100,000 lamps per day in response to increasing demands. Stocks are at present somewhat larger than earlier in the summer.

APPLIANCES.—Business remains good in various staple lines, and recent price increases appear to have had little effect in discouraging popular interest in domestic equipment. Trade has been adversely influenced, however, by the marked dulness experienced in the residential building field this summer, due largely to high cost of labor and materials. Flatirons continue in steady demand and fans are nearly sold out of many stocks.

FIXTURES.—Some improvement is noted in the fixture demand, and dealers are expecting an increased sale in September. Although factory prices have stiffened somewhat, retail prices have not as yet been increased. Stocks are in excellent shape for the fall movement, and prompt deliveries can be made in most cases covered by recent inquiry. Commercial fixtures are in fairly good demand.

ELECTRICAL SUNDRIES.—Small motors, bell transformers and other sundries are in considerable demand. A shortage in skilled labor is reported and the increase in government orders has in some cases greatly curtailed development work outside war requirements. Telephone apparatus is in great demand for war and industrial service at present. Inquiry of independent manufacturing interests regarding the possibility of supplying the present commercial shortage in Bell apparatus from outside sources leads to the opinion that little aid could be expected at present, even were the Bell interests disposed to seek it, on account of the need of extended engineering development and present activity of all manufacturing plants.

STORAGE BATTERIES.—Batteries for signaling, fire alarm, military and naval service are in great demand. No recent price advances are reported. It is rumored that a break is imminent in the price of lead, and that this may affect the market for batteries of that type.

WIRE AND CABLE.—The volume of business holds up well. Manufacturers report gaining somewhat in factory stocks. Government orders are active and installation work at the Ayer (Mass.) cantonment is proceeding very rapidly. An 8-mile transmission line to this cantonment was completed last week in six weeks' total time.

ELECTRICAL REFRIGERATING MACHINERY.—An excellent trade in this class of equipment is reported for this summer. Deliveries are growing longer and high prices still rule. Goverment orders bulk large in this field. Residential demands are very quiet at present, and little attempt to encourage this branch of the business is expected this fall.

IRON CONDUIT.—The situation remains unsatisfactory. Jobbers' stocks appear to be getting lower. No recent price movements are reported, and no immediate changes are forecast.

WATER-SPRAYING EQUIPMENT.—The Spray Engineering Company of Boston, Mass., reports that the month of June was the best in the history of the organization. Inquiries are being received from foreign countries, and recent sales include cooling ponds or equipment for China, Ecuador and Cuba. Domestic orders include the following: Consolidated Coal Company, Fairmount, Pa., cooling equipment, 20,000 gal. per minute; United Illuminating Company, Bridgeport, Conn., three air washers; Minneapolis (Minn.) General Electric Company, air washer, capacity 60,000 cu. ft.

per minute; Lackawanna Steel Company, New York, two air washers, capacity 74,000 cu. ft. per minute; United Gas & Electric Company, New Orleans, La., one air washer, capacity 50,000 cu. ft. per minute; Pittsburgh Steel Company, Pittsburgh, Pa., air washer, 45,000 cu. ft. per minute, and for the Consolidated Gas & Electric Company, Baltimore, Md., the largest washer the company has so far built, having a capacity of 125,000 cu. ft. of air per minute. At the Waterbury (Conn.) station of the Housatonic Power Company a fifty-thousand-dollar spray cooling installation is to be completed within six weeks, and a novel feature of this installation will be the supporting of the spray nozzles by Archbold-Brady structural steel frames 50 ft. over the river edge without supporting piers in the water. This construction was determined upon to avoid difficulties from ice in the neighborhood of foundations.

ATLANTA

The general building situation in the Southeast is slowing up, but activity in Atlanta seems to be increasing. The number of permits for buildings in the Atlanta fire district shows a slight increase due to lessening of pressure on government work in this vicinity.

The electrical contractors report a good business and a slight improvement over last week. Collections also continue good. Up to date the miscellaneous supply business for the Southeast shows an increase of approximately 80 per cent over 1916. This increase is accounted for by the fact that a number of concerns are rehabilitating and utilizing old apparatus for their own use or for sale at a good profit, as indicated by the great activity in second-hand machinery. On the whole, the position of the electrical business is excellent at this time.

OIL-BREAK CIRCUIT BREAKERS.—There is a very strong demand in the face of long deliveries.

APPARATUS.—The market in general is good for nearly all types of heavy equipment. Street-railway extensions to the cantonment have stimulated the demand for rotary converters.

PANELBOARDS.—Activity seems to be increasing in this line, owing probably to the finishing up of a number of business structures.

CONDUIT.—Increasing length of deliveries is apparently slowing up demand. Prices remain about the same. Deliveries of five to six weeks are being promised. Local stocks are 25 per cent below normal.

OUTLET BOXES.—There seems to be very little demand at the present time, as jobbers purchased heavily previous to the last price advance and stocks are, on the whole, in fair shape.

ELECTRIC HOISTS.—Manufacturers of this class of equipment are enjoying an excellent business, and the present manufacturing facilities are not sufficient to handle all the immediate requirements. Shipbuilding plants of all descriptions are being erected at Southeast coast cities as rapidly as material and labor will permit. This class of construction has also stimulated the lumber industry, and in most cases both of these industries have been able to secure preferential shipment on hoisting machinery as the lumber is being used for government construction in cantonments and shipyards.

THEATRICAL DEVICES.—As the many men at cantonments will require entertainment and amusement, a number of new theaters are under construction, which in turn has created a very strong demand for theatrical devices. Deliveries on theatrical devices are reported to be quite satisfactory, with the exception of dimmers, on which there is said to be a considerable delay.

TRANSFORMERS.—Sales for the Southeast covering 150 kva. and below for the first thirty weeks of 1917 show an increase of approximately 65 per cent as compared with 1916.

SWITCHBOARDS.—A number of good orders have been placed recently and there has been no break in the normal demand. Delivery promises vary from six months to one year, depending on type of equipment.

SEATTLE

Electrical interests in the Northwest report business about the same as last week, with trade active in exceptional cases. Prices rule at virtually the same level that they were on last week.

Organized lumber manufacturers in Washington recently announced a continued and practically unanimous shutdown of all Northwest lumber mills and logging camps until after Jan. 1, with the exception of those plants working on spruce for government aeroplanes. Oregon mills plan to continue operation. With the market falling and no new business in sight, Washington lumbermen state that the present strike in mills and camps has resulted in curtailing production. Mill operators are taking advantage of shut-down to make needed repairs and in some cases extensions and betterments, which means the purchase of considerable electrical equipment, including motors, transformers and switchboards. Development work in mining that would be active is being held up by labor scarcity, unsettled labor conditions and exorbitant prices for all mining supplies. Considerable equipment, however, was sold during the summer for mining work, but demand is very slight at present. A strike at the shipyards involving a majority of the Seattle plants is again probable. Credit and collections continue satisfactory. Labor in the electrical field is very difficult to obtain, and the situation is growing more serious. Reasons given are high wages in shipbuilding, plenty of other remunerative work, and the draft.

FARM LIGHTING OUTFIT.—One big Seattle firm recently inaugurated a selling campaign, and satisfactory results are confidently expected. These outfits are comparatively new in the Northwest and fill a popular demand that promises to grow.

HOUSEHOLD APPLIANCES.—Heating devices and novelties are moving satisfactorily.

MACHINERY.—Demand for electrical machinery is good. Shipments are fairly easy, but do not meet requirements.

CANTONMENTS.—Work on the American Lake cantonment is practically completed. Local electrical dealers recently filled practically the last requirements, including motors, wires, lamps and sockets.

WIRING SUPPLIES.—Copper and conduit are still in active demand, with prices about the same and shipment hard to obtain. Buying for the future is very light. Stocks are low and practically no attempt is made to replenish them. The present demand for wire and cost of same indicate that there may be scarcity in the immediate future. There is an increasing tendency to refrain from any new commitment in store, apartment-house or dwelling-house activities, although the projects for new manufacturing plants show no interruption. Because of building inactivities the sale of fixtures and sockets is very light.

LAMPS.—Lamps show satisfactory sales, although they are hard to obtain in large quantities.

SAN FRANCISCO

The greatest demand at present is for heating devices, owing probably to so many people earning good wages. There is also a noticeable activity in stocks used in shipbuilding and industrial plants, demand for the more staple lines being better than at any time during the year. Insulated wire is in fairly good shape, while bare copper is rather short. In spite of a shortage of conduit at the mills, stocks here are in good shape. Deliveries on all wires and cables and supplies are coming along nicely, except knife switches and lamp cord, on which deliveries are very slow, anywhere from six to eight months. Lamp stocks are normal, and all orders are being filled promptly from local stocks. Demand for washing machines in both city and country is increasing, with a good stock on hand. The electric range demand is increasing and stocks are generally good.

Prices remain about the same. Retail business is better than this time last year. Collections are running quite well up to average; in fact, a little better than they did last week.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard package or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists to contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List, per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 solid:	
Less than coil	$54.90 to $61.00
Coil to 1000 ft	48.80 to 59.17
No. 12 solid:	
Less than coil	63.90 to 71.00
Coil to 1000 ft	56.80 to 68.87

Twin-Conductor

No. 14 solid:	
Less than coil	$78.00 to $104.00
Coil to 1000 ft	75.00 to 80.00
No. 12 solid:	
Less than coil	121.50 to 135.00
Coil to 1000 ft	108.00 to 130.95

DISCOUNT—CHICAGO

Single-Conductor

Less than coil	List plus 10%
Coil to 1000 ft	List less 10%

Twin-Conductor

Less than coil	List plus 10%
Coil to 1000 ft	List less 10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	—10% to 12%
1/5 to std. pkg	10% to 20%
Std. pkg.	34% to 44%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	12% to +20%
1/5 to std. pkg	Net to 20%
Std. pkg.	30% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28	.29

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 30	.35	.35
50 to barrel	.31 to .318	.32 to .328
Barrel lots	.28 to .288	.29 to .298

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$67.50 to $75.00	$60.00 to $69.75
3/8-in. double strip	71.75 to 75.00	63.75 to 72.00
1/2-in. single strip	90.00 to 100.00	80.00 to 93.00
1/2-in. double strip	95.00 to 100.00	85.00 to 96.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 100 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.75	71.25
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.— $55.00	$24.50-$25.50	$21.50-$24.75
1/4-in.— $40.00-$60.00	$27.00-$30.00	$23.50-$27.00

NET PER 1000 FT.—CHICAGO

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.— $36.67-$55.00	$27.50	$23.10-$24.75
1/4-in.— $40.00-$60.00	$30.00	$25.20-$27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37
2 1/2	.58 1/2
3	.76 1/2

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.60
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	6% to 8%	8% to 10%
2500 to 5000 lb.	9% to 11%	11% to 13%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	3.8% to 8%	5.8% to 10%
2500-5000 lb.	6.8% to 11%	8.8% to 13%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

Net	$3.50

CHICAGO

List price	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.75 to $6.30
1/5 to std. pkg.	4.50 to 5.25

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.05

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $34.88
Coil to 1000 ft.	21.00 to 26.52

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$37.20 to $37.84
Coil to 1000 ft.	27.90 to 28.38

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$18.00 to $29.00

CHICAGO

Net per 100	$22.50 to $38.25

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, A.X. 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	List to 33%	List to 27%
$10.00 to $50.00 list	List to 42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$14.00 to $20.00
1/5 to std. pkg.	13.00 to 15.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80 to $20.54
1/5 to std. pkg.	13.00 to 19.24

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

	5½ N.C.—Solid Nail-it—N.C.	
Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
Less than 1/5 std. pkg.	$10.50 to $24.30	$28.00
1/5 to std. pkg.	9.75 to 12.15	21.50

CHICAGO

	5½ N.C.—Solid Nail-it—N.C.	
Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
Less than 1/5 std. pkg.	$11.85 to $26.00	$20.75 to $30.75
1/5 std. pkg.	9.00 to 20.00	16.30 to 24.20

SOCKETS AND RECEPTACLES

	Std. Pk.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15% to 20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%

SWITCHES, KNIFE

250-Volt, Front Connections, No. Fuse

High Grade:	List
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

High Grade:	
Less than $10 list	List to —5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%
Low Grade:	
Less than $10.00 list	5% to —5%
$10.00 to $25.00 list	11% to 16%
$25.00 to $50.00 list	14% to 24%

DISCOUNT—CHICAGO

Less than $10 list	5% to +5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp., three-point	100	.54
10-amp., three-point	50	.76
10-amp., 250-volt, D. P.	100	.68

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	.50	.70
10-amp. double-pole	.50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	Net to +20%
1/5 to std. pkg.	15% to Net
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 23%	18%
$2.00 to $10.00 list	20% to 23%	18%
$10.00 to $50.00 list	23% to 30%	18%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25% to 50%	15% to 40%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

Net price	$3.10 to $3.50

CHICAGO

List price	$4.50 to $5.00
Discount	25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

No. 18, less than full spools	$0.52
No. 18, full spools	0.48

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.565 to $0.6885
No. 18, full spools	0.495 to 0.56

WIRE-RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-18.00	$12.00-14.50	$11.50-12.50
12	21.06-28.35	18.96-24.30	18.01-20.25
10	29.60-39.83	26.64-34.14	25.31-28.45
8	42.40-56.49	38.16-48.42	36.25-40.35
6	72.19-89.39	64.98-76.62	61.73-63.85

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$16.00	$14.00
12	25.99-29.89	21.96-25.62	20.13-22.50
10	36.49-41.51	30.84-35.58	28.27-31.57
8	47.97-60.13	43.80-51.50	40.15-44.77
6	70.24-90.16	69.24-77.28	56.54-70.84

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$40.25 to $45.00
25 to 50 lb.	39.25 to 42.00
50 to 100 lb.	38.00 to 38.25

CHICAGO

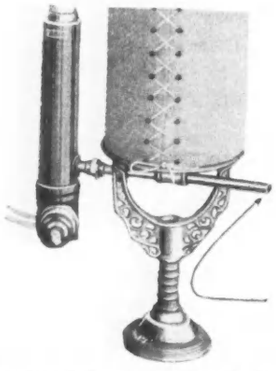
	Per 100 Lb. Net
Less than 25 lb.	$42.00 to $45.50
25 to 50 lb.	41.35 to 46.00
50 to 100 lb.	39.00 to 43.50

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Continuous-Service Electric Water Heaters

Electric water heaters of the circulation type that employ the thermal storage system—that is, they store the hot water in the regular kitchen boiler—are made by the Hughes Electric Heating Company, 5660 West Taylor Street, Chicago. This type of water heater is made in two sizes for 750-watt and 2000-watt consumption. It consists primarily of a waterproof bayonet-type heating element inserted in a metal casing which is adequately insulated by a tightly packed insulating material ¾ in. (1.9 cm.) thick. This heating element is placed squarely in the center of the water flow, and all heat generated is absorbed into the water, making the heater 100 per cent efficient, it is claimed. This heater can be attached to any kitchen boiler in the same manner as the gas circulation heaters or the coal and wood waterback heaters are installed. The heater is easily cleaned by unscrewing the bolts at the bottom and removing the heating element without disconnecting the body of the heater.



CIRCULATION-TYPE WATER HEATER

Sixty-Day Portable Signal Battery

Portable signal batteries which, it is claimed, will operate a busy signal circuit for sixty days on one charge, even in summer weather, have recently been put on the market by the Electric Storage Battery Company, Philadelphia. Attention is called to the fact that the grids and separators have been made more rugged, the rubber jars more substantial, and additional sediment space provided. A double-flanged cover is used, which protects the upper edges of the jar from mechanical injury, while the automatic vent and filling plug prevent careless overfilling of the cells and the consequent slopping of electrolyte over the covers and carrying case. This cover also acts as a spray trap, preventing the escape of acid spray while charging. The increase from thirty-day to sixty-day service is largely obtained by a design of cell which eliminates internal losses, rather than by increasing the amount of active material, since the sixty-day battery weighs only 25 per cent more than the thirty-day battery.

Electric Broiler for Hotel Kitchens

The General Electric Company of Schenectady, N. Y., has developed a hotel broiler which has a sheathed-fire heating unit, with two heats, consuming 2500 and 5000 watts respectively, in the top of the broiling chamber. The top of the chamber is provided with 2 in. (5.08 cm.) of heat-insulating material to prevent radiation of heat upward. The heating unit is operated by a double-pole knife switch on the top of the broiler. The broiler is furnished complete with a substantial drip pan and a gridiron on which the meat is placed. The gridiron is supported below the unit on a movable frame which may be raised or lowered by means of a lever on the side of the broiler near the front.

GRIDIRON IS SUPPORTED ON A MOVABLE FRAME

Coffee Filter

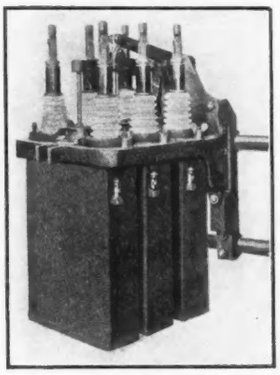
The latest addition to the line of coffee filters manufactured by the Silex Company, 45 High Street, Boston, Mass., is an outfit equipped with a "water control." By means of this feature water is retained in the lower of the two compartments composing the coffee maker until it reaches the boiling point, when it is released from the lower compartment and rises into the upper section, containing finely pulverized coffee. When the current is disconnected the filtered coffee returns to the lower container. "Pyrex" glass is used in the construction of the filter, which, it is claimed, eliminates metallic flavor.

Oil Switches for Voltages Up to 23,000

To its line of type B oil circuit breakers the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has added the two types of breakers designated as type B-2 and B-3, for use on alternating-current circuits up to 23,000 volts. Type B-2 breakers have a carrying capacity of from 300 amp. to 2000 amp.; type B-3 of from 300 amp. to 1200 amp.

Distinctive features pointed out are rigidly clamped porcelain pillar bushings, self-cleaning butt-brush contacts, auxiliary arcing contacts and spring-accelerated opening.

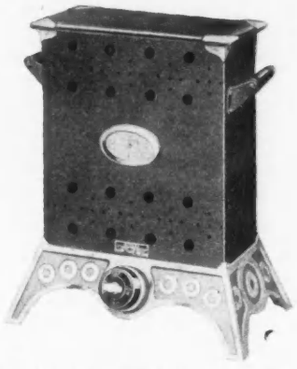
Type B-2 breakers are furnished for panel mounting, hand operation, or for wall or pipe-frame mounting, electrical operation. Type B-3 breakers are furnished for wall or pipe mounting only, for hand operation through bell cranks or for electrical operation. For both types tripping may be either automatic or by hand. Hand-operated breakers are actuated by a handle projecting through a cover plate on which is mounted the automatic trip coil (if any). When the breaker is electrically operated the trip coil is mounted on the face of the panel. Remote-control breakers operated by bell cranks and rods are provided with a spring to assist the force of gravity in opening. A dashpot brings the moving parts to rest without shock.



CIRCUIT BREAKER WITH SELF-CLEANING BUTT-BRUSH CONTACTS

Portable Electric Air Heaters

Portable electric air heaters that are especially desirable for sickrooms, bathrooms and bedrooms, nurseries, studios, box offices and similar places are made by the Hughes Electric Heating Company, 5660 West Taylor Street, Chicago. These heaters are instantly regulated, may be moved to any part of the room, do not diffuse noxious fumes and do not burn the oxygen of the air, it is claimed. These air heaters are made in six sizes, each with and without switches—ranging from 1000 watts to 4000 watts rating. The heaters have black-enameled steel bodies and bases of cast iron finished in nickel.



THIS AIR HEATER DOES NOT DIFFUSE NOXIOUS ODORS

Floodlight Projectors

An enlarged line of floodlighting projectors for various purposes that embody the use of a 14-in. (35.6 cm.) glass mirror, either of "Golden Glow" or "Crystal" glass, the particular type suited for any purpose depending largely upon the functioning of the eye under the given condition, are announced by the Electric Service Supplies Company of Philadelphia. The mirrors used are true paraboloids.

The only difference between "Crystal" and "Golden Glow" mirrors is in the quality of the glass employed, the former being of clear crystal glass, while the latter is greenish-yellow in color. The projected light from a "Crystal" mirror projector is white. The "Golden Glow" projectors project a flood of soft golden-yellow light, owing to the fact that the "Golden Glow" mirror alters the spectral quality of the light received from the incandescent bulb before projecting it into the beam.

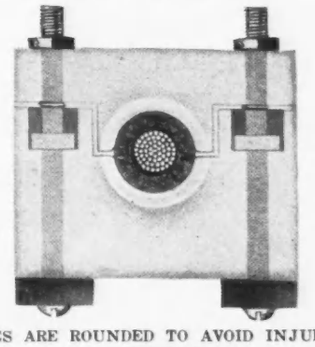
Since the light from the "Crystal" mirror projector is white and spectacular, it should be used on all floodlighting jobs where spectacular results are desired. The "Golden Glow" light should be used in floodlighting all utilitarian objects; it should be used for all objects in which the eye must be able to disclose fine detail, or where it is to be called into continuous use.

Both the 14-in. (35.6 cm.) "Golden Glow" and the "Crystal" mirror projectors are adapted to take a 400-watt Mazda C concentrated-filament floodlighting lamp, and by the use of an adapter any medium screw-base lamp may be employed, such as the 200-watt Mazda C floodlighting lamp, or any other standard concentrated-filament lamps designed for headlight or stereopticon service. With this wide range of lamps to select from, it is readily seen to what a wide variety of uses these projectors may be put.

Equipped with a 400-watt floodlighting bulb, these projectors give a maximum beam candlepower of more than 250,000, with a beam dispersion of 12 deg. By drawing the filament of the bulb slightly behind the focal point of the reflector the dispersion may be increased to 16 deg., the candlepower decreasing to approximately 140,000. Controlling the dispersion in this manner enables the beam to be most effectively controlled for any particular purpose.

Cleat-Type Switchboard Insulator

Cleat-type insulators, designed particularly for high-voltage switchboard construction, that lend themselves to low-voltage work as well, are made by the Electrical Development & Machine Company of Philadelphia. The clamping members composing the insulator grip the cable uniformly between two circular tube-like surfaces approximately 2 in. (5.08 cm.) in length. All edges are rounded to avoid any possibility of injuring the cable covering because of forcing sharp corners or grooved inner surfaces into the insulation. It is pointed out that this type of insulator practically doubles the length of surface leakage path to ground. Attention is called to the fact that the lower half of the insulator may be bolted to its support and properly aligned before the wire or insulated bus is fastened in position. The Philadelphia Electric Company, Supply Department, 132 South Eleventh Street, Philadelphia, is the selling agent for this cleat insulator.



EDGES ARE ROUNDED TO AVOID INJURING OF CABLE

Face Shield for Electric Welders

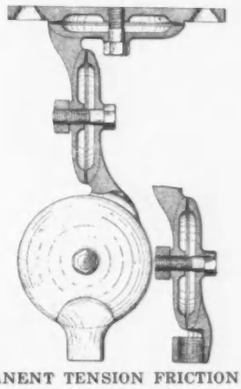
Face shields that are light in weight, being constructed of aluminum and vulcanized fiber, are made by the Ideal Face Shield Company, 468 North Garfield Avenue, Columbus, Ohio. The shield is supported entirely upon the head of the operator. Another feature which the makers call attention to is the ease with which the operator can open and close the door containing the colored glasses, thus making it convenient for him to examine his work without removing the shield. When the door is thus opened there is still a clear glass which protects the eyes from any flying particles. The shield also prevents the possibility of a glare or reflection from the side or rear, and an apron of fireproof material protects the chest of the operator from his own arc.

Porcelain Pull Sockets and Receptacles

For outdoor installations, cellars, in factories, etc., where a metal pull socket would be seriously damaged by the weather or other corroding influences, the General Electric Company of Schenectady, N. Y., recommends its porcelain pull socket, G.E. 639. This socket takes the "Standard" G.E. pull-socket interior and is therefore interchangeable in metal and porcelain shells. Sockets are furnished with ⅛-in. (3.2-mm.), ⅜-in. (4.8-mm.) and pendent caps, 250 watts and 660 watts rating. Receptacles are furnished with bases for cleat and concealed work, as well as bases for 3¼-in. (8.2-mm.) and 4-in. (20-mm.) outlet boxes. The caps, bodies and bases are interchangeable.

Adjustable Light Holder

The Franklin Specialty Manufacturing Company of Providence, R. I., has developed a permanent tension universal friction joint for use with light holders. In the accompanying illustration is shown the ceiling type, the principle of this type applying to the scores of combination joints and sizes already in use. The maximum frictional resistance is obtained by having the point of contact at the extreme outer edge of the disks. The hollowed-out centers produce a resilient tension which, it is claimed, remains constant for years without readjusting. The clamping screws pass through one disk and screw through the opposing disk. The nut locks the adjustment permanently.



PERMANENT TENSION FRICTION JOINT

Trade Publications

GENERATING SETS.—The Universal Motor Company of Oshkosh, Wis., is distributing bulletin No. 26, descriptive of its 4-kw. generating set.

INSULATORS.—The Electrose Manufacturing Company of Brooklyn, N. Y., is distributing a bulletin descriptive of its Electrose insulators for voltages of from 1000 to 1,000,000.

ELECTRIC RECORDERS.—The Wight Electric Recorder Company of Brookside Park, Cleveland, Ohio, is distributing a bulletin descriptive of its electrical boiler water level recorder and high and low alarm.

SHADES AND REFLECTORS.—Shade bulletin No. 25, descriptive of the shades and reflectors made by the Faries Manufacturing Company of Decatur, Ill., is now being distributed. This bulletin includes a revised list of prices of this line of fixtures.

REFLECTORS.—The National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, Ill., is distributing an industrial lighting number of Eye Comfort, published to aid advocates of good lighting. This number includes information on the Beehive line of industrial lighting reflectors, two pages of reasons why X-ray industrial lighting is best, a full page about the special demonstration package and a page of sales helps.

PROTECTIVE DEVICES.—The Condit Electrical Manufacturing Company, South Boston, Mass., is distributing several bulletins descriptive of its electrical protective devices. This set includes bulletin No. 413, descriptive of oil switches and circuit breakers; bulletin No. 415, descriptive of current and potential transformers, and bulletin No. 416, descriptive of induction and synchronous motor panels and type C-3 overload relays for use with alternating-current motor starting devices.

INDUSTRIAL TRUCKS.—The General Vehicle Company, Inc., at Long Island City, New York, is distributing a bulletin descriptive of its industrial trucks. This bulletin gives a brief résumé of the possibilities of the electrical industrial trucks. A brief description is also given of the standard 2000-lb. type truck, including satisfactory performance data under various conditions, interesting time studies, and increased practicability and efficiency. Many photographs of actual uses are given in this book.

FLOODLIGHTING PROJECTORS.—In its general floodlighting catalog the Electric Service Supplies Company of Philadelphia publishes a list of some 125 subjects suitable for floodlighting. This list is further subdivided for purposes of convenience into four distinct groups—(a) esthetic subjects, (b) advertising subjects, (c) pleasure subjects, (d) utilitarian subjects. This catalog, besides listing the projectors proper, takes up such subjects as general characteristics of floodlighting, floodlighting projectors, characteristics of parabolic reflectors., quality of light for floodlighting, floodlighting subjects, intensities of illumination required, photometric characteristics of projectors, covering power of projectors, circular projection, elliptical projection, searchlights and general floodlighting rules.

ELECTRICAL APPARATUS.—The General Electric Company of Schenectady, N. Y., is distributing the following bulletins: Bulletin No. 44417A, descriptive of GE-258 ventilated commutating-pole railway motors; bulletin No. 47380A, descriptive of safety-first inclosed lever switches, types LM-1, LM-2 and LM-3; bulletin No. 45600-A, descriptive of vacuum tube lightning arresters; bulletin No. 48319A, descriptive of CR-1340 and CR-1342 pressure-controlled, speed-regulating panels with automatic pressure regulator; bulletin No. 49301, descriptive of varnished cambric and paper-insulated cables; bulletin No. 49302, descriptive of wires and cables; general bulletin No. 49303, descriptive of splicing materials and junction boxes for underground cable systems, and bulletin No. 49304, descriptive of conductors insulated with vulcanized rubber compound.

CIRCUIT BREAKERS.—"Oil Circuit-Breaker Accessories" is the title of a bulletin (DS272) recently issued by the Westinghouse Electric & Manufacturing Company. Trip-magnet frames and coils are listed for obtaining underload, undervoltage, overload, overvoltage, series and shunt trip. Several, and in some cases all, of these can be applied on the same breaker to act with the standard automatic overload trip mechanism. For controlling the operating circuit of electrically operated breakers, control switches are listed. There are described and listed signal switches, inverse-time element attachments, bell-alarm signal-contact attachments, ball-crank accelerating devices, universal mounting brackets for mounting breakers, instrument transformers and other accessories on the rear of the panel or on a separate pipe or angle-iron frame.

New Incorporations

THE J. L. HADLEY ELECTRIC COMPANY, Covington, Ky., has been incorporated by John A. Glindmeyer, J. L. Hadley and Emma Glindmeyer.

THE FLINT (MICH.) STORAGE BATTERY COMPANY has been incorporated, with a capital stock of $5,000, by R. A. Welch, H. F. Hanning and James A. Watson.

THE BUCKLE ELECTRIC COMPANY of Salt Lake City, Utah, has been incorporated by J. V. Buckle, M. M. Allison, J. G. Larison and others to do a general contracting business.

THE DOUBLE LIFE STORAGE BATTERY & SERVICE COMPANY of Chicago, Ill., has been incorporated, with a capital stock of $5,000, by Ward S. Perry, J. F. Henning and E. J. Frietag.

N. J. GORKE, INC., Syracuse, N. Y., has been incorporated by H. J. Gorke, K. S. Gorke and D. Gorke, Syracuse, to make electrical goods, supplies and equipment. The company is capitalized at $50,000.

THE AUTOMATIC ELECTRIC CONTROLLER COMPANY of Seattle, Wash., has been chartered, with a capital stock of $250,000, by J. C. Arnold, E. C. Kilbourne, H. McMullen and R. W. A. Simmons.

THE SPRINGDALE (ARK.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $50,000. The officers are George D. Locke, president; F. L. O'Neal, vice-president, and H. L. Hughes, secretary-treasurer.

THE NORTHPORT POWER & LIGHT COMPANY, Northport, B. C., has been organized to supply light and power to the Nelson district. One of the directors is Lorne A. Campbell, of the West Kootenay Power & Light Company.

THE ELECTRIC SPECIALTY MANUFACTURING COMPANY of St. Louis, Mo., has been chartered, with a capital stock of $5,000, by H. T. V. Perry, H. Perry and M. T. Lewis. The company proposes to deal in electrical specialties.

THE ANDERSON ELECTRIC SALES COMPANY of New York, N. Y., has been chartered, with a capital stock of $500, to deal in electrical machinery. The incorporators are: Frank C. Rose, Joseph E. Ward and Bailey C. Elliott.

THE BRYANT (IND.) ELECTRIC COMPANY has been incorporated by Orville, D. Arnold, James Rupel, Henry Huckreide and J. C. L. Whiteman. The company is capitalized at $10 000, and proposes to generate and distribute electricity.

THE OHIO GAS & ELECTRIC CORPORATION OF DELAWARE of Wilmington, Del., has been chartered, with a capital stock of $500,000. The incorporators are Clement M. Enger, Winfield S. Randall, and Herbert H. Ward, Jr., of Wilmington, Del.

THE STRYKER DEFLECTOR COMPANY of Buffalo, N. Y., has been incorporated, with a capital stock of $5,000, to manufacture the Stryker patent light deflector. The incorporators are: J. H. Prescott, D. Porter and C. L. Stryker of Buffalo, N. Y.

THE BAY RIDGE ELECTRICAL COMPANY of Brooklyn, N. Y., has been chartered, with a capital stock of $5,000, to deal in electrical goods, motor vehicles, etc. The incorporators are: Daniel F. MacDonald, Alexander M. Stagg and John F. Warner.

THE GENERAL LIGHT, HEAT & POWER COMPANY, INC., New York, has been incorporated by S. B. Howard, George V. Reilly and Louis H. Gunther, all of New York, to carry on the business of mechanical and electrical engineers. The company is capitalized at $3,000,000.

THE FOGELSVILLE & TREXLERTOWN ELECTRIC COMPANY of Topton, Pa., has been chartered, with a capital stock of $5,000, by W. J. Martin of Topton; D. S. Martin and S. R. Rothermel of Reading. The company proposes to supply electricity for lamps, heaters and motors in Upper Macungie Township.

THE ENGEL-KELLY ELECTRICAL NEUTRALIZER MANUFACTURING COMPANY of St. Louis, Mo., has been incorporated by Jacob A. Engel and others. The company is capitalized at $20,000, and proposes to manufacture a device for neutralizing the static electricity which develops on paper stock when it is being printed.

THE MARBLE-CARD ELECTRIC COMPANY of Gladstone, Mich., has been organized, with a capital stock of $60,000 to manufacture direct-current, commutating-pole motors and dynamos for all classes of service. The incorporators are: F. H. Van Cleve, J. T. Jones, W. L. Marble and J. F. Card. Ground is being broken for the erection of a factory building 60 ft. by 140 ft., one story high.

Trade Notes

THE ROSS HEATER & MANUFACTURING COMPANY, INC., announces the removal of its offices from 753 Bird Avenue to 504 Mutual Life Building, Buffalo, N. Y.

V. L. CRAWFORD, formerly of Hubbard & Company, is now in charge of sales of the B & K Manufacturing Company, manufacturer of pole line and bracket hardware, New Britain, Conn.

THE OSTERHOUT ELECTRIC COMPANY, Philadelphia, Pa., has leased property at 1013 Race Street for a new electrical supply establishment. Frederick C. Osterhout is head of the company.

THE ADAMS-MORGAN COMPANY, Montclair, N. J., has been organized to operate an electrical specialty plant on Aborn Place. Alfred P. Morgan, 69 Brookfield Road, Montclair, heads the company.

C. A. MUDGE, formerly with the United States Light & Heat Corporation, Niagara Falls, N. Y., has severed his connection with that company to become general manager of the Electro Dynamic Company, Bayonne, N. J.

THE CALEBAUGH SELF-LUBRICATING CARBON COMPANY, Columbia Avenue, Philadelphia, Pa., manufacturer of carbon brushes for generator and motor use, has removed its plant to 1508-1518 Columbia Avenue for increased operations. Offices will be maintained at 1503 Columbia Avenue.

EDWARD L. FRANTZ has just disposed of his entire stock interest in the Frantz Premier Company of Cleveland, Ohio, and resigned his office of vice-president and general manager, thereby entirely severing his connection. Mr. Frantz is the founder of the company and one of the pioneers in the vacuum cleaner industry.

WESTINGHOUSE SALES FORCES.—John Shoolbred has recently been added to the Boston staff of the Westinghouse Electric & Manufacturing Company as a commercial engineer on industrial motor problems. R. M. Keck has been appointed a supply department salesman at Dallas, succeeding D. S. Pryde, who has resigned Joseph A. Summers is a new salesman at Charleston, W. Va. He will handle supplies, replacing R. T. Robinson, who has resigned. W. E. Smith and J. T. Watson have recently been attached to the Bluefield (W. Va.) staff. Mr. Watson will handle industrial motors and Mr. Smith will handle supplies. W. C. Walke is a recent addition to the industrial motor sales staff at Pittsburgh.

WESTINGHOUSE ESTABLISHES A PRACTICAL COURSE FOR FOUNDRYMEN.—Owing to conditions with which industrial managers are only too familiar, there is a great demand for trained foundrymen in responsible positions. To insure itself a supply of such men the Westinghouse Electric & Manufacturing Company has recently established a course in foundry work for those of its employees between the ages of seventeen and twenty-one years who have completed at least the eighth grade of public school or its equivalent. The shop courses will include the following: Bench and floor molding, machine molding, core making, tempering of sand, cupola operation, mixing of alloys, cost calculating. Classroom instructions will be given during the course on blueprint reading, mechanical drawing, shop problems and metallurgy, particular attention being given to the alloys of iron and copper. The company plans to give those desiring it a thorough all-round knowledge of this phase of its work.

New England States

CLAREMONT, N. H.—The installation of a new 44,000-volt transmission line, extending from Claremont to Charleston, has just been completed by the Claremont Power Company.

PORTSMOUTH, N. H.—The Morley Button Company will build a one-story addition to its power plant for factory operation.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is planning for the early operation of its new substation at Castleton, which will be used for local service. The company has also completed the construction of a new high-tension line from Rutland to Castleton.

CLINTON, MASS.—Paul E. Meissner, president of the Roubaix mill, is planning the construction of a one-story brick power house to be added to the present mill.

DORCHESTER, MASS.—It is planned to erect a white-way system in Dorchester from Eaton Square to Geneva Avenue.

FALL RIVER, MASS.—The Union Street Railway Company is planning to build a new power station to meet increasing demands upon its generating capacity. The building will be erected upon the company's wharf, at the foot of Middle Street. It will be of brick, 80 ft. by 115 ft. and 70 ft. high. It will be equipped with a 30-ton crane. Contracts have already been placed for the Babcock & Wilcox boilers; also for the electrical equipment. The plans for the new power plant were prepared by the Harry M. Hope Engineering Company, Boston. Work will be started immediately.

FLORENCE, MASS.—Work has been commenced on the new two-story addition to the power plant of the Nonotuck Silk Company. The structure will be about 25 ft. by 30 ft.

NEW BEDFORD, MASS.—Work has been started on the large addition to the power plant at the foot of Cannon Street of the New Bedford Gas & Edison Light Company. The addition will be built of brick, concrete and steel, 60 ft. by 90 ft. and 75 ft. high. It will be a thoroughly fireproof building throughout and will house a 15,000-kw. turbine-driven generator and auxiliary electrical equipment. Stone & Webster, Boston, are the engineers and contractors.

READSBORO, MASS.—The New England Power Company's petition for authority to issue securities of the par value of $7,000,000 has been granted by the State gas and electric lighting commission. A dam will be built at Readsboro just over the line in Vermont, and will be about 200 ft. high. The power plant will have an installed capacity in waterwheels of about 36,000 hp.

WORCESTER, MASS.—D. Shapiro filed a petition with City Clerk W. Henry Towne asking the City Council to consider the installation of a lighting system on Arthur Street, north of Dorchester Street.

PROVIDENCE, R. I.—Plans are being completed for a power plant and distributing system for the United States government. F. R. Harris, chief of bureau of yards and docks, Navy Department, Washington. The cost will be about $450,000.

MERIDEN, CONN.—The H. Wales Lines Company of Meriden, Conn., has been given the contract to build an addition to the power plant at the factory of A. & E. Henkels on Connecticut Avenue. The addition will be of brick with a gravel roof. Work will be started immediately.

PLAINVILLE, CONN.—The Trumbull Electric Manufacturing Company has awarded the contract for a new factory building to be erected adjacent to its present plant.

SOUTHINGTON, CONN.—A special meeting of the Board of Selectmen will be called for the purpose of making an appropriation to pay for the lighting of the streets during the coming year.

WATERBURY, CONN.—The Housatonic Power Company, West Main Street, has had plans prepared for the construction of a new two-story addition to its power plant on Freight Street. The structure is estimated to cost about $25,000.

Middle Atlantic States

BROOKLYN, N. Y.—W. B. Armstrong, Albany, has been awarded a contract for the installation of new power plant equipment at the Brooklyn State Hospital, Brooklyn, at $19,948.

BUFFALO, N. Y.—Plans have been filed by the Buffalo General Electric Company for the erection of a new transformer station on Gladstone Street.

CARTHAGE, N. Y.—The new additions to the plant of the Newton Falls Power Company at Newton Falls are nearing completion. The new power plant will develop 1000 hp. and is expected to be in operation on Nov. 1.

DUNKIRK, N. Y.—It is planned to adopt a new post-lighting system for the business streets of Dunkirk.

DUNKIRK, N. Y.—The electric light department has about completed the work of stringing a high-tension wire, it is reported, to the new Catholic college being erected at Hemlock Grove, to supply that institution with electricity.

FULTON, N. Y.—The Dilts Machine Company has had plans prepared for the construction of a new hydroelectric power plant to be used for the operation of its gate-hoisting machinery works on North First Street. Frank Dilts is president.

LOCKPORT, N. Y.—The last machinery for the new hydroelectric power station at Lockport, N. Y., has been installed, enabling the Hydraulic Race Company of that city to develop an additional 1600 hp. from the surplus waters of the Erie Canal at the Lockport locks.

NEW YORK, N. Y.—The Electric Bond & Share Company, 71 Broadway, has increased its capital from $1,600,000 to $2,000,000.

POUGHKEEPSIE, N. Y.—The Wallace Company, Main Street, has awarded a contract to Kingston & Campbell, 1 Washington Street, for a one-story brick and concrete heating plant at its factory, to cost about $25,000.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has started work on two new underground conduit systems. One extends through Ridge Road from Lake Avenue to the city line and the other extends from Driving Park Avenue bridge through that street to St. Paul.

BLOOMFIELD, N. J.—An appropriation of $21,750 is planned by the Town Council for street lighting for 1918.

CAMDEN, N. J.—The asylum and almshouse committee of the Board of Freeholders is planning for the construction of new pumping plants and joint heating system at the county institutions.

DOVER, N. J.—Construction of the extensions to the new station of the New Jersey Power & Light Company outside the city limits has been completed and the company is planning to discontinue the use of the old city steam plant on North Sussex Street, the entire load to be carried by the new plant.

ENGLEWOOD, N. J.—The Board of Education will receive bids until Sept. 5 for electrical equipment in the new Lincoln School on Englewood Avenue. A. S. Coe, secretary.

GARFIELD, N. J.—The Garfield Worsted Mills has had plans prepared for the erection of a new boiler house addition for plant operation. Lee & Hewitt, 1123 Broadway, New York, are the architects.

GLOUCESTER CITY, N. J.—An appropriation of $12,000 for street lighting has been approved by the Common Council for 1918.

HADDONFIELD, N. J.—The installation of a new street-lighting system is being considered by the borough officials. It is planned to install incandescent units to replace the arc lamps now in service.

LAKEWOOD, N. J.—The Board of Public Utility Commissioners has granted the Lakewood & Coast Electric Company permission to issue stock and certificates of indebtedness to the amount of $20,500 for improvements.

NEWARK, N. J.—The building committee of the Common Council will receive bids Sept. 4 for lighting fixtures and a refrigerating plant to be installed at the City Hospital. Thomas J. Lee, Jr., chairman.

NEWTON, N. J.—The Sussex Print Works has had plans prepared for the construction of a new boiler house, 50 ft. by 150 ft., to cost about $10,000.

PERTH AMBOY, N. J.—Plans have been completed for the installation of a new commercial street-lighting system in the business section of the city, which will include a new underground conduit system and will be operated by the municipal electric light plant. Bids will be received until Sept. 17 by the committee on streets of the Board of Aldermen. Runyon & Carey, 843 Broad Street, Newark, are the engineers.

PRINCETON, N. J.—The Public Service Electric Company is planning for the installation of underground lines on Nassau Street to replace its overhead system.

TRENTON, N. J.—The City Commission has completed the installation of an ornamental lighting system in Mahlon Stacy Park.

TRENTON, N. J.—Bids will be received until Sept. 11 for improvements and new equipment at the boiler plant of the State Home for Boys, Jamesburg. The work will include the installation of pumping machinery, piping, and a new radial brick stack. Francis H. Bent, State architect, State House, is the architect.

TRENTON, N. J.—The Board of Trenton City Commissioners has handed down an order instructing the Trenton & Mercer County Traction Company to remove its overhead lines and poles on Monmouth, Kent, Prospect, Globe, Division, Hudson and a number of other streets. The commission holds that the company did not have the authority to construct these lines, and that other arrangements for installation must be made.

UNION HILL, N. J.—The Borough Council has approved an appropriation of $14,700 for street-lighting during the coming season.

WEST ORANGE, N. J.—The Town Council has approved an appropriation of $25,000 for street lighting. George W. Foster, town clerk.

CARROLLTOWN, PA.—The Penn Central Electric Company, Johnstown, is planning for the construction of a new transmission line to Carrolltown, and will furnish service for street lighting.

CHELTENHAM, PA.—The Hoffman, DeWitt & McDonough Company will build a new one-story boiler plant at its braid factory.

DAUPHIN, PA.—The boiler plant of the William P. Zortman Lumber Company was recently destroyed by fire with a loss of about $10,000. The structure will be rebuilt.

ELIZABETHVILLE, PA.—The Wiconisco Telephone Company has commenced the construction of a new line at Millersburg, Pa.

HARRISBURG, PA.—The Workmen's Non-partisan League has adopted resolutions favoring the establishment of a municipal light, heat and power plant.

HARRISBURG, PA.—The Public Service Commission has granted permission to the following companies to issue bonds to the amount voted for improvements and extensions: Penn Central Light & Power Company, Altoona, $78,000; the Edison Electric Company, Lancaster, $230,000; the Philadelphia Suburban Gas & Electric Company, Philadelphia, $168,000, and the Mahoning & Shenango Railway & Light Company, Pittsburgh, $500,000.

JARRETTOWN, PA.—Residents of Jarrettown are signing petitions for the installation of an electric lighting system. A meeting with representatives of the electric light company will be held early in September.

JOHNSTOWN, PA.—The Johnstown Traction Company is planning for the extension of its lines in the Seventh and Seventeenth Wards and in Coopersdale.

LANCASTER, PA.—The General Hospital has awarded a contract to Herman Wohlsen, Lancaster, for the construction of a new one-story boiler plant about 60 ft. by 65 ft.

LOCK HAVEN, PA.—An ordinance has been passed for the execution of a contract with the Lock Haven Electric Light, Heat & Power Company for the lighting of the streets of the city for a period of five years.

MILLERSBURG, PA.—The Public Service Commission has granted permission to the Millersburg Electric Company to build a new transmission line from Halifax to New Buffalo, by way of Clemson's Island.

PHILADELPHIA, PA.—The Philadelphia General Hospital will build a new one-story power plant, 50 ft. by 150 ft., on Thirty-fourth Street, for service for the institution.

PHILADELPHIA, PA.—H. H. Collins, 226 Columbia Avenue, has filed plans for the construction of a new engine house addition to his plant at 1436-1444 North Sixth Street.

PHILADELPHIA, PA.—O'Neill Brothers have awarded a contract for the construction of a new one-story brick boiler house to their plant to William Marriott, 3020 North Second Street.

PHILADELPHIA, PA.—The Atlantic Refining Company has filed plans for the construction of a one-story brick power plant, about 41 ft. by 42 ft., at its works at Thirty-sixth and Jackson Streets, to cost about $21,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

PHILADELPHIA, PA.—The Pennsylvania Railroad has awarded a contract for the construction of a new one-story power house at its Girard Point works for plant operation, to John N. Gill & Company, 1215 Filbert Street, Philadelphia.

PHILADELPHIA, PA.—The Department of Public Health and Charities, City Hall, is receiving bids up to Sept. 12 for the construction of a new one-story power house at the institution on Thirty-fourth Street. P. H. Johnson, 110 South Broad Street, is architect.

PITTSBURGH, PA.—The Pennsylvania Railroad, Union Station, will build a power plant for works operation at its new roundhouse, machine and repair shops near Indianapolis, Ind.

PITTSBURGH, PA.—The Rex Hide & Rubber Compay, East Brady, will build a power plant in connection with a new factory building. The W. E. Moore Company, Union Bank Building, is engineer.

POTTSTOWN, PA.—The Eastern Steel Company will install a new converter and auxiliary equipment at its works.

POTTSTOWN, PA.—The installation of new electrical equipment at the Glasgow works of the Nagle Steel Company has been commenced.

READING, PA.—The Public Service Commission has approved the proposed merger of the Reading Transit & Light Company, the Metropolitan Electric Company, the United Traction Company, the Birdsboro Street Railway, the Boyerstown & Pottstown Railway Company, the Front & Fifth Street Railway Company and the Reading & Womelsdorf Electric Railway Company. The new organization will be known as the Reading Transit & Light Company. The merger is said to involve about $10,000,000.

SAYRE, PA.—The Sayre Electric Company has just completed improvements and betterments in its power plant. Automatic stokers have been installed.

BALTIMORE, MD.—An appropriation of $3,000,000 is being considered by the United Railways Company for extensions and betterments in its system during the coming four years.

BALTIMORE, MD.—A new one-story power house to cost about $20,000 will be constructed by the Baltimore Dry Docks & Shipbuilding Company at its works on East Fort Avenue. Contract for erection has been awarded.

GARY, W. VA.—The United States Coal & Coke Company owns properties in Letcher and Harlan Counties, Ky., of which 20,000 acres will be developed. The company plans to install electric machinery to provide for a capacity of 10,000 tons daily. Howard N. Eavenson is chief engineer.

MORGANTOWN, W. VA.—The West Virginia Traction & Electric Company is making rapid progress in the construction of a new transmission line in this district.

NORFOLK, VA.—The Bureau of Yards and Docks, Navy Department, will build a new central power station and distributing system at its local navy yard, to cost about $800,000.

WASHINGTON, D. C.—The Potomac Electric Power Company is reported to have completed plans for the construction of its proposed new power house on Benning Road, N. E. The structure will cost about $40,000.

WASHINGTON, D. C.—The Bureau of Yards and Docks, Navy Department, has given a contract to the Blumenthal-Kahn Electric Company, 505 Eutaw Street, Baltimore, Md., for the installation of a new lighting system in the foundry to be constructed at the Portsmouth Navy Yard, at $10,000. The bureau has also awarded a contract to the Carroll Electric Company, 714 Twelfth Street, for installing a similar system in the new machine shop at the same location, at $12,000.

North Central States

MUSKEGON, MICH.—Work has been started on an addition to the substation of the Consumers' Power Company at Muskegon Heights.

CLEVELAND, OHIO.—Sealed proposals will be received at the office of the commissioner of purchases and supplies, room 219, City Hall, until 12 o'clock on Sept. 13, 1917, for furnishing and installing complete an 84-in. Venturi meter.

CLEVELAND, OHIO.—The Turner Construction Company, 244 Madison Avenue, New York, has received a contract from the Cleveland Electric Illuminating Company for the reinforced-concrete work at its new power plant, which will be about 125 ft. by 300 ft.

CLEVELAND, OHIO.—Light Commissioner W. E. Davis has assured business men on Lorain Avenue that work on the new "white way" lighting system on that street, between West Twenty-fifth and West Fifty-eighth Streets, will be started very soon. The Lorain Business Men's Association has raised $6,000 to be applied on the cost.

KENTON, OHIO.—Plans are being made for the building of a "white way" system to extend two blocks from the Court House Square.

LEIPSIC, OHIO.—The Village Council has notified the Northwestern Ohio Light Company that unless better service can be given within thirty days the franchise will be revoked.

MANSFIELD, OHIO.—The Ohio Electric Light & Power Company, which has a big plant at Mount Vernon, has strung wires to Belleville, and according to reports the line will be extended to Johnsville and Lexington.

MANSFIELD, OHIO.—The Melco power plant of the Mansfield Electric Light & Power Company was recently destroyed by fire. The loss included electrical equipment which was to have been installed in the main building and is estimated at $10,000.

SANDUSKY, OHIO.—Arrangements are being made by the Sandusky Gas & Electric Company for the construction of a new transmission line to be connected with the system of the Lake Shore Electric Company.

WHITESBURG, KY.—The Kentucky Solvay Company of Grennough has begun the erection of a power plant, the cost of which will be $100,000.

ELWOOD, IND.—R. E. Breed, president of the Indiana General Service Company of Elwood, filed a petition with the Public Service Commission of Indiana for permission for his company to buy the Marion Light & Heat Company and the Muncie Electric Light Company and consolidate them with the Elwood company.

REMSEN, IOWA.—Construction of the first unit of the power plant that is to be built at the Dalton sandpit for the Iowa Light, Heat & Power Company has been commenced by Zack Eyers, who received the contract for the structure.

KANSAS CITY, MO.—Walter Root of the Jackson County Anti-Tuberculosis Society and H. R. Ennis, president of the Board of Public Welfare, placed a proposition before the hospital and health board to furnish the Tuberculosis Hosp'tal at Leeds with electric light and power.

FREMONT, NEB.—The Fremont Gas, Electric Light & Power Company is installing a turbine-driven generator of 500-kw. capacity at its plant at H Street and the Northwestern tracks.

ORD, NEB.—An election to vote $30,000 in bonds to build a new electric light plant will be held on Sept. 11. O. P. Cramwell, clerk.

Southern States

ATLANTA, GA.—T. H. McKinney, Inc., contracting electrical engineer of Atlanta, has been awarded the entire contract for installing electricity at Camp McCleland, Anniston.

MACON, GA.—The Home Electric Light & Power Company has filed notice of increase in its capital from $50,000 to $100,000.

JOHNSON CITY, TENN.—The Beaver Creek Coal Company is planning to electrify its properties near Alphoretta, Ky., by the installation of electric operating machinery, electric locomotive and kindred apparatus. S. R. Jennings is president.

MOUNT PLEASANT, TENN.—The Republic Light & Power Company of Chattanooga, Tenn., has purchased the Mount Pleasant Electric Light Company and will enlarge and improve the local plant.

OAKDALE, TENN.—It is planned to install new electric equipment at the proposed new plant of the Oakdale Hosiery Mills. S. N. Oakley, head.

BIRMINGHAM, ALA.—The first unit of the new steam-power plant erected by the Alabama Power Company as an auxiliary to its hydroelectric plant will be in operation soon. The cost of the initial installation is $1,850,000.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company is planning for the construction of a new transmission line to Alma and vicinity for the furnishing of service to the Citizens' Electric Company for local distribution. The construction of a new electric generating station to be erected on the Arkansas River is also planned by the company. The new station will have a capacity of 5000 hp.

Pacific and Mountain States

SEATTLE, WASH.—A special election has been called for Sept. 11 to vote on an ordinance covering a plan to acquire or construct a municipal light and power plant for Seattle. It is estimated that the cost of constructing a plant would be $7,000. It is proposed to obtain a site on Maloney Creek. Paul Fournier, clerk.

TACOMA, WASH.—The City Council has authorized the purchase of a 500-kw. motor-generator set, comprising a 4000-volt alternating-current motor and a 600-volt direct-current generator, together with a concrete substation building, at a total cost of $22,000.

JOHN DAY, ORE.—The Consolidated Electric Light Company has been leased by Horace Johnson and J. N. Pocock of Canyon City, for a period of five years. Negotiations will be entered into for lighting Canyon City.

PORTLAND, ORE.—Engineers working on the Interstate Bridge have recommended that motor-generator sets be installed, so as to make use of 11,000-volt lines to operate the bridge in case the voltage on the Portland Railway & Power Company's line is lowered.

FRESNO, CAL.—Work has been started on the erection of a new substation to be built by the San Joaquin Light & Power Company.

LOS ANGELES, CAL.—Charles E. Stokes filed a petition with the city clerk urging the City Council to provide for the ornamental lighting of the new concrete bridge across the Arroyo Seco between Southern Pasadena and Garvanza.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company plans to extend its electric power lines all through the county, it was reported, following the company's application to the supervisors for a fifty-year franchise throughout the county.

SAN DIEGO, CAL.—Plans for the development of two big water systems in San Diego County and the building of a huge power plant to furnish power for San Diego County and the Imperial Valley have been announced by the Edward Fletcher Company. Incorporation papers were filed in the County Clerk's office for the Warner Mutual Water Company, incorporated for $6,000,000, and the Pamo Mutual Water Company, for $4,750,000. The Warner company will build a dam at the Warner dam site and a power plant from which power will be furnished to a number of companies. The Pamo company will build three dams, one at the San Clemente site, at Linda Vista, one at the Sutherland site, at Ramona, and one at the Pamo site, at the head of the San Pasqual Valley.

SAN FRANCISCO, CAL.—The Railroad Commission has authorized the San José Railroads and the Peninsular Railway Company to transfer to the Pacific Gas & Electric Company for $6,400 a transmission line, including poles, wires, etc., along the right-of-way of the two railroads from San José to Saratoga; also the stationary motor system of the railroads in Santa Clara County, for $62,500.

SANTA ANA, CAL.—The Southern California Edison Company is building two important lines, one down the west side of the Santa Ana River and along the coast, and the other on the Santa Ana side of the river, across the Irvine ranch and through to San Juan Capistrano by the inland route.

ANACONDA, MONT.—It is planned to erect an ornamental street-lighting system on South Montana Street similar to that in the downtown business district.

Canada

PORTAGE LA PRAIRIE, MAN.—The city light committee contemplates the installation of one 100-hp. boiler with mechanical stoker, costing about $5,000. D. McGowan, clerk.

ST. JOHN, N. B.—The city has voted to spend $2,000 for rewiring the old post office. R. C. Desbrochers, secretary Public Works Department, Ottawa.

BLOOMFIELD, ONT.—A by-law has been passed to provide $8,000 for development of electric energy. Charles H. Saylor, clerk.

TORONTO, ONT.—The Toronto Hydro-Electric System has been granted permission to construct a wrought-iron conduit from the corner of Front and John Streets to the main pumping station.

WELLINGTON, ONT.—A by-law was voted on to provide $10,000 for the development, transmission and distribution of electric energy. E. A. Titus, clerk.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co. Annual meeting, Birmingham, Ala., Oct. 23, 1917.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, Arthur Kneisel, 29 South LaSalle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual convention, Pittsburgh, Oct. 3-6.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City. Annual meeting, Jan. 14, 1918.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg University of Pennsylvania, Philadelphia.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary-treasurer, Roy B. Fowles, Pine Bluff, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, George C. Holberton, San Francisco, Cal. Annual meeting, New York, Sept. 11, 1917.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, McKeesport, Pa. Annual convention, Philadelphia, Sept. 10-14.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, W. L. Connelly, Gibson, Ind.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, E. Brettell, Electric Supply Company, Ltd., Vancouver, B. C.

CALIFORNIA ASSOCIATION OF CONTRACTORS AND DEALERS. Secretary, James W. Redpath, 505 Rialto Bldg., San Francisco, Cal.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, Alan Sullivan, Excelsior Life Building, Toronto, Can.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer. T. F. Kennedy, 900 15th St., Denver, Col. Annual convention, Colorado Springs, Col., Sept. 20-22.

COMMERCIAL SECTION, N. E. L. A. Secretary, F. D. Beardslee, Union Electric Light & Power Company, St. Louis, Mo.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Company, Schenectady, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF CONNECTICUT. Secretary, George M. Chapman, Waterbury, Conn. Annual meeting, New Haven, Conn., May, 1918.

ELECTRICAL CONTRACTORS' ASSOCIATION OF MASSACHUSETTS. Secretary, J. E. Wilson, 263 Summer Street, Boston, Mass.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo. Annual meeting, Jan. 19, 1918.

ELECTRICAL CONTRACTORS' ASSOCIATION OF THE STATE OF PENNSYLVANIA. Secretary, M. G. Sellers, 1518 Sansom St., Philadelphia.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, J. C. Staff, 578 Jackson St., Milwaukee, Wis.

ELECTRICAL DEALERS AND CONTRACTORS' ASSOCIATION OF ONTARIO. Secretary, E. A. Drury, 45 Murray St., Toronto, Can.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, H. B. Crouse, Crouse-Hinds Co., Syracuse, N. Y.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert E. Elliott, 34 Ellis St., San Francisco, Cal.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Affiliated with the N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York. Annual meeting Oct. 5.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, L. W. W. Morrow, Norman, Okla. Annual meeting May, 1918, Oklahoma City.

GEORGIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, Dan Carey, Atlanta Builders' Exchange, Atlanta, Ga.

ILLINOIS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. B. Van Nuys, Central Electric Co., Peoria, Ill. Annual meeting Chicago, January, 1918.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, R. H. Abbott, Petersburg, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INDIANA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, George Skillman, Indianapolis, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, David Sarnoff, 111 Broadway, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Sept. 11-14, 1917, Niagara Falls, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre. 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, M. T. Humphrey, Waterloo, Iowa.

IOWA SECTION, N. E. L. A. Secretary-treasurer, L. E. Caldwell, Iowa City, Iowa.

JOVIAN ORDER. Jupiter (president), Henry L. Doherty, New York City; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo. Annual convention, October.

KANSAS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, R. M. Sutton, Wichita, Kan.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan. Annual meeting, Salina, Kan., Oct. 19 and 20, 1917.

KENTUCKY ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary, F. F. Valinoti. Annual meeting May, 1918, Louisville, Ky.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 323 Chartres St., New Orleans, La.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Augusta, Me.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Monroe, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, H. E. Young, Minneapolis General Electric Company, Minneapolis, Minn.

MINNESOTA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, G. M. Jones, 112 South Seventh St., Minneapolis, Minn. Annual convention, Jan. 20, 1918, Minneapolis, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, W. F. Wheeler, Hattiesburg, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Concord, Mass. Annual convention, New York, March, 1918.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, H. C. Brown, 41 Martin Building, Utica, N. Y. Next meeting, New Orleans, Oct. 10-13, 1917, New Orleans, La.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343-1349 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee. Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, B. P. Egan, Room 201, Union Pacific Building, Omaha, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, E. A. Thiele, Roswell, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York. Annual meeting June, 1918.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York.

NORTHWEST SECTION, N. E. L. A. Secretary, J. F. Farquhar, Washington Water Power Company, Spokane, Wash. Annual convention, Spokane, Wash., Sept. 12-15.

NORTHERN WHITE CEDAR ASSOCIATION. Secretary, R. N. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus. Annual meeting, Columbus, Ohio, Nov. 15, 1917.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary-treasurer, J. W. Oberender, 301 Dekum Building, Portland, Ore. Annual convention, Eugene, Ore., Sept. 17 and 18, 1917.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, Crossley Building, San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa. Annual convention, Bedford Springs, Pa., Sept. 7 and 8.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, Thomas J. Styles, 152 Beech St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual meeting, Evanston, Ill., June, 1918.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, Frederick D. Brown, Huron, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, Thomas W. Peters, Columbus, Ga. Annual convention, Birmingham, Ala., Oct. 23-26.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, H. C. Bower, 602 Metropolitan Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, Forrest E. Baker, 721 First National Bank Building, El Paso, Tex.

TEXAS STATE ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary, H. S. Ashley, Fort Worth, Tex. Annual meeting, Galveston, Tex., June 15, 1918.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Charlotte, N. C., April, 1918.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, C. H. West, Rutland, Vt. Annual meeting February, 1918.

VIRGINIA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. M. Andrews, Richmond.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 Jackson Building, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, 1410 First National Bank Building, Milwaukee, Wis.

14,343. EXTENSION SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Jan. 31, 1912. Improvements.

1,237,290. ELECTRIC SOLDERING IRON; George F. Browning, Toppenich, Wash. App. filed March 2, 1917. May be used continuously without requiring periods of heating.

1,237,306. DYNAMO-ELECTRIC GENERATOR; Alfred H. Darker, Blackheath, England. App. filed March 15, 1915. Means for regulating or controlling the generation of current in cases where the dynamo is connected up with a battery or batteries and a consuming circuit.

1,237,320. SIGNAL DEVICE; Gordon Fox and Tony M. Jewett, Cleveland, Ohio. App filed Aug. 29, 1913. Adapted for use in factories, stores and similar places where it may be necessary or desirable to make signals from one or more points of control.

1,237,329. SYSTEM OF CONTROLLING MOTORS AND THE LIKE; William L. Hamilton, Glasgow, Scotland. App. filed March 29, 1915. The application of the power required for starting the drive in the forward direction may be initially controlled by hand actuation, and the subsequent operations up to and including the stopping of the drive at its termination in the reverse direction may be effected entirely automatically, although, if required at any stage, the drive may be interrupted by hand actuation.

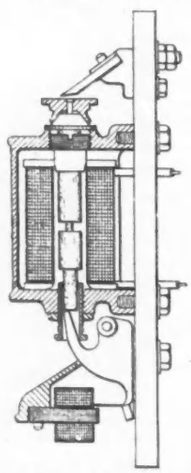
1,237,370. CUT-OUT SWITCH; Thomas E. Murray and Arthur V. A. McHarg, New York, N. Y. App. filed Jan. 10, 1917. So constructed that an aperture in the wall of the casing whereby access may be had to the parts within said casing is closed by a swinging shield when said switch is closed, and opened when said switch is opened.

1,237,371. APPARATUS FOR BENDING METAL PLATES; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed May 5, 1917. For electrically softening a certain portion of a metal plate and for bending said plate at said softened portion.

1,237,379. METER-TESTING CONSTRUCTION; Clarence D. Platt, Bridgeport, Conn. App. filed Dec. 4, 1916. Contemplates the use of a special type of plug and cords for each set of jaws to be connected to the test meter.

1,237,401. MEANS FOR PREVENTING CURRENT LEAKAGE IN ELECTRIC CABLES; Severn D. Sprong and Walter E. McCoy, New York, N. Y. App. filed Dec. 12, 1916. Pot-head for the end of a high-tension cable, so constructed as to prevent current leakage from the conductors of said cable to the metal of the pot-head.

1,237,411. LAMP HANGER; Allison J. Thompson, Cleveland, Ohio. App. filed Feb. 9, 1914. Applies to devices utilized in supporting a lamp in a manner such that it



1,237,226—Induction-Motor System

may be raised and lowered from the ground by a rope or other similar connection.

1,237,454. MOTOR CONTROLLER; Thomas E. Barnum, Milwaukee, Wis. App. filed May 24, 1915. Means adapted to operate under the direction of a simple push-button station to afford an exceedingly flexible control of the motor, including starting and acceleration thereof to different predetermined degrees by different operations of a single push-button switch.

Record of Electrical Patents

Notes on United States Patents issued on August 21, 1917

1,237,459. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; Joseph Bijur, New York, N. Y. App. filed Dec. 6, 1913. Provides an armature in which the grooves and teeth are so formed as to permit the use of a greater amount of winding, or more coils, with an armature of a given diameter, than has been possible in armatures as heretofore constructed.

1,237,517. PROGRAM CLOCK; Archie P. Honey, Crosby, Minn. App. filed July 17, 1916. Includes a plurality of signals such as signal bells with means whereby each bell may be energized according to a predetermined program without interfering with any other bell, by this means providing for a change of program at any time.

1,237,518. MOTOR CONTROLLER; Albert J. Horton, White Plains, N. Y. App. filed Jan. 9, 1915. Improvements.

1,237,559. BALANCER; Shiro Sano, Tokyo, Japan. App. filed Aug. 22, 1916. The principle of the "balancer" is to give between the earth-plates and the Wheatstone bridge or any other instrument of similar nature an equal and opposite electromotive force.

1,237,584. SYSTEM OF ELECTRICAL DISTRIBUTION; Percy H. Thomas, Upper Montclair, N. J. App. filed July 12, 1916. Relates to circuits for operating mercury-vapor rectifiers from multiphase alternating-supply circuits.

1,237,592. ELECTRICAL HEATING UNIT; Louis R. White, Bennington, Vt. App. filed Oct. 21, 1915. For domestic purposes.

1,237,611. TERMINAL CONNECTION FOR ELECTRIC LAMPS; Robert B. Brownlee, East Orange, N. J. App. filed Feb. 11, 1914. Improvements.

1,237,638. SYSTEM OF RECTIFICATION; Arthur P. Haase and Frank D. Pearne, Chicago, Ill. App. filed Aug. 5, 1915. Improvements.

1,237,648. ELECTRICAL SYSTEM; John W. Jepson, Depew, N. Y. App. filed Aug. 8, 1912. Improvements.

1,237,649. APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS; Oscar I. Judelsohn, Brooklyn, N. Y. App. filed July 10, 1915. Provides a casing or box to inclose the electric controlling devices, and is provided with a cover or door that is adapted to control means to prevent operation of the switch arm of the apparatus in the event that the cover be left open.

1,237,653. METHOD OF CLEANING AND RENEWING ELECTRIC LAMPS; Frederick G. Keyes, East Orange, N. J. App. filed Jan. 28, 1914. Principle of the method consists in withdrawing the air from the lamp to be treated and forming in situ on the glass walls a volatile compound of tungsten.

1,237,681. INDUCTION MACHINE; Alfons H Neuland, San Francisco, Cal. App. filed Oct. 2, 1913. Provides an induction machine capable of operating at a variable speed and a variable torque as well as a simple means of starting a motor from rest.

1,237,682. DYNAMO-ELECTRIC MACHINE; Alfons H. Neuland, San Francisco, Cal. App. filed June 17, 1914. Means for substantially decreasing the reaction due to the opposed magnetic flux of inductor alternators with a high frequency per revolution, thereby materially improving their regulation.

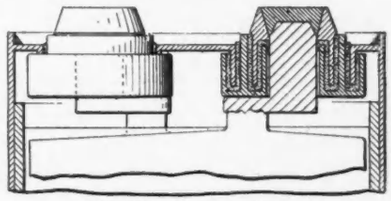
1,237,718. SPRING BATTERY CLIP; Francis H. Speice, Dubois, Pa. App. filed Dec. 30, 1916. Quickly applied to a binding post or removed therefrom, and will produce an excellent electrical connection therewith.

1,237,733. STORAGE BATTERY; Theodore A. Willard, Cleveland, Ohio. App. filed Sept. 30, 1915. Means for sealing the terminal posts so as to prevent leakage of acid to the exterior of the cover, and also for insulating the posts and connectors from the cover.

1,237,775. ALTERNATING-CURRENT ELECTRICAL INSTRUMENT OF THE MOVING-COIL TYPE; Randolph D. Gifford, Chingford, England. App. filed Jan. 18, 1915. In which the moving element consists of or includes a conductor traversed by an alternating current, or a rectified alternating current, or a varying or interrupted continuous current.

1,237,807. SWITCH BOX; Harry O'Connor, Port Huron, Mich. App. filed Sept. 10, 1915. Provides means to prevent persons from connecting into an electric circuit before the passage of the current through a meter.

1,237,810. GUIDING DEVICE FOR WRAPPING MACHINES; Frank M. Pierce, Chicago, Ill. App. filed Feb. 21, 1916. Improvements.



1,237,733—Storage Battery

1,237,811. ADJUSTING MECHANISM FOR WRAPPING MACHINES; Frank M. Pierce, Chicago, Ill. App. filed Feb. 21, 1916. The article may be positioned according to its size to receive a wrapper applied thereon.

1,237,812. PAPER FOLDER; William B. Pierce and Frank M. Pierce, Chicago, Ill. App. filed Jan. 2, 1915. Improvements.

1,237,843. INSULATOR SUPPORT FOR TOWERS; John W. Ward, Latrobe, Pa. App. filed Dec. 24, 1915. Consisting of a series of plates or disks built in combination to form an insulated base for support of heavy towers, and which are constructed of solid material for compressive strength to sustain heavy loads.

1,237,857. ELECTRIC COUPLING; Rex G. Averill, Mansfield, Ohio. App. filed March 16, 1916. Between cars.

1,237,915. ELECTRIC WELDING APPARATUS; Laurence S. Lachman, New York, N. Y. App. filed Jan. 19, 1916. Means to prevent creeping of the plates when the welding is done consecutively at separate points in the surface of the metal sheets.

1,237,933. MICROPHONE WITH CARBON-POWDER FALL FOR STRONG CURRENTS; Giovanni B. Marzi, Cornigliano Ligure, Italy. App. filed Feb. 12, 1914. Renews continually the carbon which forms the contacts of variable resistance so that it cannot become heated.

1,237,944. INDUCTION DEVICE; Alfons H. Neuland, New York, N. Y. App. filed Sept. 1, 1915. Produces an induction machine in which the rotor when in electrical synchronism with the revolving field has a lower angular velocity than the field.

1,237,953. AUTOMATIC SUBSTATION; Claude W. Place, St. Louis County, Mo. App. filed June 25, 1915. Provides a substation which shall be entirely automatic, thus dispensing with any need for continuous attendance, and shall operate, in accordance with the load conditions of the distribution circuit, when it may be needed.

1,237,973. AUTOMATIC SUBSTATION; Edward Taylor, Chicago, Ill. App. filed July 7, 1915. Sequence of operation of the various switches controlling the rotary transformer is exactly determined, and also that the intervals between the operation of the various switches are properly controlled.

1,237,993. SAFETY BURGLAR-ALARM LOCK FOR WINDOWS; Carl H. A. Bahde, Milwaukee, Wis. App. filed July 5, 1916. Has particular application to means for locking both sashes of the window together in any adjusted position of the sashes so as to prevent relative movement thereof.

1,238,027. ELECTRIC-SIGN SYSTEM; Malcolm E. Launbranch, Chicago, Ill. App. filed Jan. 22, 1916. Improved system of operating and controlling signs of this character.

1,238,066. ELECTRIC SPEED OR PRESSURE-CONTROL DEVICE; Charles A. Mullen, Sistersville, W. Va. App. filed Oct. 5, 1916. Relates to governors for explosive engines responsive to the pressure of fluid delivered by a pump driven by the engine or to speeds of a moving part driven by the engine.